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NEWER ASPECTS OF RUPTURED INTERVERTEBRAL DISKS*

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INSPECTION OF THE SPINAL COLUMN explains the cause of defective lumbar intervertebral disks, their frequency and the fact that they are nearly always multiple or potentially multiple. The key to these disclosures lies in the lateral facets of articulation between the vertebrae. The first and second lumbar articulations parallel the spinous processes and prevent not only lateral but little forward, backward or side motion. At the third lumbar articulation the lateral articulations usually, but not always, begin to turn outward from the horizontal plane, and as far as 25°. The fourth articulation turns laterally to as much as 45°, and the fifth may reach 90°. Doubtless the purpose of the directional shift in the facets is to provide movement and flexibility of the spinal column, but at the same time it creates a potential weakness in the spinal column. There are many variations at all of these points and much asymmetry between the two sides but this tendency is always present. In addition, some of the facets are round, others oval; some concave and convex, others flat. These differences account for further weakness at these points.

The sequence of events in low back pain and sciatica is, I think, as follows: (1) A sudden, severe lift, or twist, tears the capsule at the lateral articulations, and loosens the joints. (2) These loose joints automatically throw an additional strain on the intervertebral cartilages, which is the third component in the articulations between the vertebrae. (3) The result of this sustained trauma is an injured disk which protrudes and impinges upon the emerging spinal nerve lying immediately in contact with the intervertebral disk.

Since the three articular facets of the three lower vertebrae participate in the anatomic variation, the high incidence of multiple disks is to be expected and actively obtains in practically all cases. In at least 5 per cent of the cases three disks are present at the time of operation, or will subsequently develop. Without a proper appreciation of multiple disks, any operative treatment will be ineffectual. This is one of the principal reasons for the disappointing results in the past.

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TEST FOR MOBILE JOINTS

When the articular facets become loose the whole vertebral junction is similarly affected. The abnormal mobility can be determined at operation by pushing a spinous process in the horizontal direction. And, conversely, if this test shows mobility there are defective articular facets and at the same time a defective disk. This test is, I think, absolute with one exception, *i.e.*, when the roentgenogram shows a reduced interspace; a fusion or partial fusion has then occurred and this may or may not reduce or entirely eliminate the movement, the result depending upon the duration and degree of fusion. This is nature's attempt at curing a disk—the contents of the disk having gradually absorbed over a period of many years, but the protrusion may remain and compress the nerve.

TREATMENT

Nature's method of absorbing a disk is the key to the proposed surgical treatment, *i.e.*, complete or essentially complete removal of the affected disks. This is done by thoroughly curetting the interior of the disk, extracting its contents and at the same time removing the protruding portion. The end-result is fusion of the entire vertebral surfaces. There have now been 30 cases in which at an earlier period a single disk has been removed and return of symptoms necessitated reopening the wound for a second disk; after six months the vertebrae at the site of the first operation are absolutely fixed when the disk has been completely removed. Unless a disk is thoroughly removed (*i.e.*, if only the protruding sequestrum of cartilage is extracted) the surfaces will not fuse, the joint remains mobile and it is more than probable that a new protrusion (recurrence) will form. The end-result of a cured disk is, therefore, firm fusion of the apposing surfaces of the vertebrae. Furthermore, by this treatment, when properly done, a cure must result and if the pain returns another disk must be the cause.

IDENTIFICATION OF DISKS

There are varying degrees of protrusion of disks; the smaller ones, that would not show with contrast media in the spinal canal, I have termed "concealed" disks, and these are two-thirds to three-quarters of the total number. Some of these bulge only slightly, but they fluctuate and in most instances are bound to the surrounding epidural tissues by adhesions which indicate that they must have protruded more than appears at operation. It might well be asked whether some of these are really abnormal. I am not sure. At necropsy much the same appearance has been found but without adhesions, *i.e.*, they protrude slightly and fluctuate. Of this I am certain, if there is abnormal mobility of the joint, removal of the disk is the only method of obtaining successful treatment, and it will be successful. With periodic backaches there is always a loose joint and this is almost the only cause of such backaches. Moreover, there is no difference, except in the degree of

sciatica, between the cases having large protrusions and those with the concealed disks.

It is natural to ask why fusions by autogenous grafts to the lumbar spine will not accomplish the same result. The answer is that with a graft fusion the protruding disk is merely covered up and continues to cause sciatica. And in several cases that have been fused the backache persists as well as the sciatica because of the defective disk. There can be no fusion so complete and effective as that obtained by denuding the broad surfaces of the vertebrae. Moreover, fusion by removing the disks is simple and requires but a week or ten days in the hospital. A spinal graft is a big performance and requires a plaster encasement for six weeks and a prolonged stay in the hospital, and will not produce a cure.

DIAGNOSIS AND LOCALIZATION OF THE DISKS

Neither the diagnosis nor the localization of disks require intraspinal injections. They miss over two-thirds of the disks (concealed disks) and the history alone is almost pathognomonic, *i.e.,* periodic attacks of low backache plus sciatica, both usually (but not always) made worse by coughing and sneezing (because of the mobility of the joint). The *localization* of the defective disk or disks (mobile joints may be preferable) is perfectly simple and certain by the mobility test* described above. The only possibility of error in diagnosis is a spinal cord tumor. These occur in a little less than one per cent of the cases. This is, indeed, a difficult and often impossible differential diagnosis to make solely from routine examinations, but is no excuse for subjecting the 99 per cent to intraspinal injections. If the diagnosis is suspected a lumbar puncture alone is indicated—the fluid will be xanthochromic if a tumor is present; there may or may not be a positive Queckenstedt test. I have missed five tumors in the series of 900 disks—700 patients.

Recently we have treated 15 cases of backache without sciatica, six with congenitally defective lumbar vertebrae, and ten with spondylolisthesis, by the same procedure, *i.e.,* removal of the intervertebral disks to produce vertebral fusion. The results in backache without sciatica are precisely the same as those with sciatica. Sufficient time has not elapsed to determine the results in the defective vertebrae and spondylolisthesis.

Before concluding I should like to call attention to a medical classic that I have never seen mentioned, namely, that of Goldthwaite, of Boston, published in 1911. The anatomic weakness of the spinal column to which I have alluded has long been known to orthopedists and has been considered by them to be the potential source of low back pain and sciatica. Indeed Ghormley has very aptly called it the "facet syndrome" which is probably responsible for the backache. But Goldthwaite not only described the ana-

* This test was shown to me by Dr. Ray E. Lenhard when demonstrating a congenitally defective lumbar vertebra. It was then tried on the disk cases and found to be all-important.

tomic variation of the three lumbar facets and ascribed to them the low backache, but he postulated the development of ruptured intervertebral disks upon the same basis, and this was 18 years before the first disk was found at operation. This remarkable anticipation of ruptured disks and their cause was made from careful studies in the anatomical laboratory and was prompted by a negative surgical exploration in one of his patients whose symptoms he always maintained could only be caused by a ruptured intervertebral disk.

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SPONDYLOLISTHESIS*

ANALYSIS OF FIFTY-NINE CONSECUTIVE CASES

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SPONDYLOLISTHESIS has been recognized for more than a century. Etiologic theories still differ although most writers agree that the defect is congenital in origin. Clinical recognition of the condition was confined at first to those cases in which forward slipping of the spine had occurred (spondylolisthesis). It has only been a few years since roentgenologic technic has made possible the recognition of defects of the neural arch even when there has been no displacement (prespondylolisthesis, spondylolysis). There can be little doubt that low back pain may be caused by the defect in the neural arch despite the fact that slipping cannot be demonstrated. Likewise, the condition may be asymptomatic even if the displacement is Grade IV (Meyerding's classification). The absence of symptoms in many cases, regardless of the extent of displacement, makes evaluation of treatment difficult.

Incidence.—The incidence of spondylolisthesis and spondylolysis, with and without symptoms, has been estimated from anatomic studies to be about five per cent, but can be determined accurately only when careful and exact roentgenologic studies of the lumbosacral region have been made on a large group of persons without regard to back complaints. Whether or not there is an inherited tendency toward such defects cannot be determined until a number of family groups has been studied. Among 61 members of one family Friberg[1] observed 15 persons with spondylolisthesis, only three of whom had symptoms although all but one were engaged in heavy labor.

TABLE I

SPONDYLOLISTHESIS AND SPONDYLOLYSIS OBSERVED AT THE OCHSNER CLINIC

January 1, 1942–November 1, 1943

Spinal fusion	8
Brace or corset	26
No treatment	15
Incidental finding	5
Incomplete data	5
Total	59

Fifty-nine cases of spondylolysis and spondylolisthesis were seen at the Ochsner Clinic from January 1, 1942 to November 1, 1943 (Table I). This number represents 0.3 per cent of all admissions to the Clinic during

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this period. The average age, sex distribution, site and occupation are shown in Table II. Between January 1, 1943 and June 1, 1943 there were

TABLE II

	Spondylolysis	Grade I	Grade II	Total
Average age	39	39	36	38
Sex—Male	9	21	4	34
Female	7	16	2	25
Site—				
L IV on L V		5		5
L V	15	32	6	53
Unknown	1			1
Occupation—				
Sedentary	8	28	6	42
Labor	7	5		12
Unemployed	1	2		3
Unknown		2		2

152 cases with low back complaints, 15 (10 per cent) of which were found to have neural arch defects (Table III). Of the 152 cases 82 were re-

TABLE III

INCIDENCE OF SPONDYLOLISTHESIS TO LOW BACK PAIN

January 1, 1943—June 1, 1943

	No. of Cases	No. of Cases
Low back pain		152
Examined in orthopedics	82	
Spondylolysis or spondylolisthesis	15	
Incidence of spondylolisthesis to low back pain		9.9%
Incidence of spondylolisthesis to orthopedic complaints		18.3%

ferred to the Orthopedic Department for examination, and of these, 18.3 per cent were found to have spondylolisthesis or spondylolysis. Thus, it is seen that among those with low back complaints severe enough to require medical attention, one out of ten is liable to have spondylolysis or spondylolisthesis and of those referred to Orthopedics after other conditions have been ruled out, one out of five has neural arch defects. Thus, spondylolisthesis represents one of the commonest causes of low back pain seen by the orthopedist.

Since the classic description of spondylolisthesis by Turner and Tchirkin[2] in 1925, most clinical descriptions have followed the same pattern. This is misleading, however, since it portrays an advanced case (Grade IV), whereas most of the cases seen now are spondylolysis, or Grade I spondylolisthesis, and have symptoms and signs similar to other low back lesions and spondylolisthesis can be differentiated only by roentgenographic examination.

History.—In most reported series the average age is around 35 years, and the duration of symptoms prior to examination about seven years. In approximately half the patients there is a history of abrupt onset of symptoms associated with injury or with repeated heavy lifting strains. In my series of 54 cases, 27 (50 per cent) gave a history of trauma. Pain is felt in the lower lumbar region at the lumbosacral junction usually extending to both sacro-iliac joints and radiating either to the groins and down the anterior aspect of the thigh or along the course of the sciatic nerve,

occasionally as far as the leg and ankle. In most cases symptoms completely disappear when the patient lies down and rests. The more severe symptoms are often caused by standing in one position or by bending and stooping or attempting to lift.

Physical Examination.—Physical examination may be almost completely negative or may reveal a definite apparent deformity with serious limitation of motion, muscular spasm and disability. Although the lumbar lordosis is often exaggerated, in some cases the back is perfectly flat. Some degree of muscular spasm is present in most patients with active complaints and is associated with definite limitation of motion at the lumbosacral junc-

FIG. 1.—Lateral and 35° anteroposterior views showing bilateral defects of the neural arch.

tion. Typical shortening of the back, increased prominence of the buttocks and iliac crest and an abrupt stepping-off of the spine at the level of the spinous process of the fifth lumbar vertebra is present only in those cases with third and fourth degree spondylolisthesis. In none of my series, which included only spondylolysis and Grades I and II spondylolisthesis, as revealed in the roentgenograms, was the displacement great enough to be determined by inspection or palpation at physical examination. In most cases the pain of which the patient complains is reproduced when the patient is lying on his back by hyperflexing the spine and rocking the pelvis from side to side. Tenderness is usually sharply localized to the spinous process of the fifth lumbar vertebra (or the fourth, when this is the level of the lesion) with slighter tenderness in the lumbosacral angle on either side.

Roentgenologic Examination.—The importance of precision in making routine roentgenograms of patients with lumbosacral pain cannot be too strongly emphasized. The most exacting technic should be employed and should include a *minimum* of three views, because routine anteroposterior and lateral views fail to visualize the neural arch defects unless gross displacement has occurred. The three views are: (1) Direct anteroposterior

view; (2) a true lateral view focussed on the fifth lumbar vertebra; and (3) a 35° anteroposterior view, with the rays directed toward the head and centered between the sacrum and fifth lumbar vertebra (Figs. 1 and 2). This projection has been used routinely by Dr. E. H. Little, Director of the Department of Roentgenology, for examination of the lumbosacral region and has been found to be most helpful. These views will clearly define any neural arch defect with separation—and most of them without separation. Unilateral neural arch defects may require confirmation by 45° oblique lateral films, but these are not essential for routine examination, although they confirm the findings and visualize them better. In my series of 59 cases there were 16 with spondylolysis, nine of which had only unilateral defects, 37 had spondylolisthesis, Grade I, and six had spondylolisthesis, Grade II.

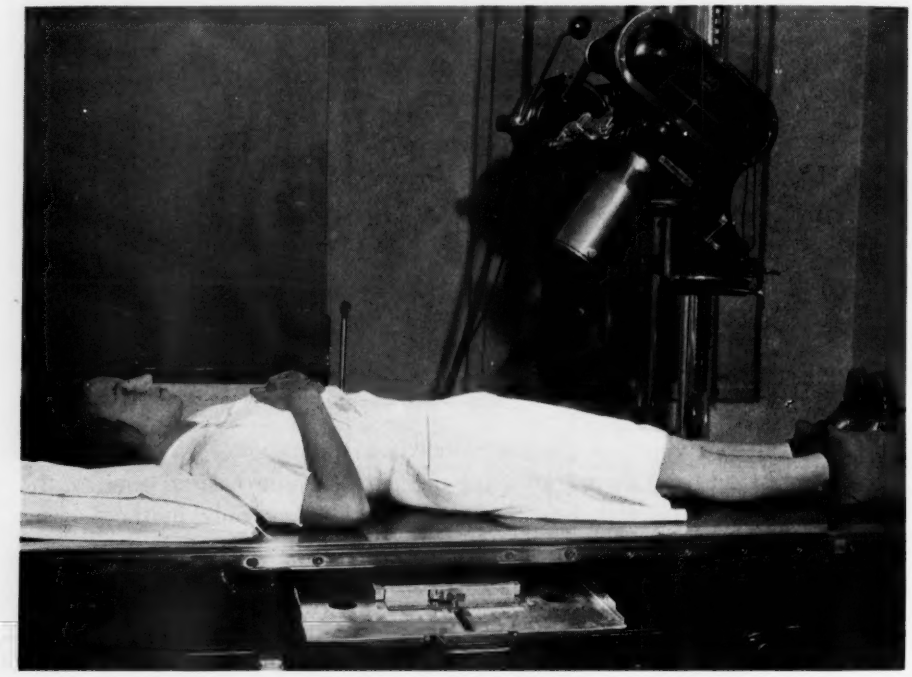

FIG. 2.—Illustration of technic used in making 35° anteroposterior view.

The diagnosis of spondylolysis and spondylolisthesis, Grades I and II, therefore, necessarily hinges upon the roentgenologic findings, since symptoms and physical examination may suggest any of the low back lesions, such as lumbosacral arthritis, ruptured intervertebral disk, unstable asymmetrical articular facets or other anomalies.

Production of Symptoms.—Most investigators have attributed the symptoms of spondylolisthesis to progressive displacement with consequent drag upon the supporting muscles and ligaments and nerve roots in the vicinity. This assumption appears plausible since all degrees of displacement are

observed and in many cases the symptoms date from trauma which might increase the stretch and strain or actual displacement of the spinal column on the subjacent sacrum or vertebra. Nevertheless, the theory of progressive slipping was questioned, in 1937, by Bakke,[3] who reported a small series of cases with no slipping after being under observation for several years, and about the same time Brofeldt[4] also stated that slipping had not been proved in any published case. In 1939, Friberg,[1] of Stockholm, published an excellent monograph, "Studies on Spondylolisthesis," based on a review of 280 patients observed between 1927 and 1938, personally interviewed and examined by the author and supplemented with detailed, competent roentgenologic studies made at intervals of two to ten years and compared with former films. He endeavored to answer two questions: (1) At what age does slipping occur? (2) How do results of surgical treatment compare with those of conservative therapy? This was a most comprehensive, thorough and painstaking analysis, the accuracy of which cannot be doubted. In regard to the first question, he concluded that because the number of children examined for spondylolisthesis was too small and was observed over too short a period, nothing definite could be established regarding the onset of slipping. He further reported that in 142 nonoperative cases a change of position of the body was noted in ten cases; in only two was this change in the sagittal direction. Both of these had Grade IV spondylolisthesis when first examined between the ages of 10 and 15 years. Having excluded slipping as a cause of symptoms, he suggested that arthritic changes, noted in many of his cases might possibly produce the pain.

On the other hand, George[5] who, in 1939, reported observations on 91 cases of spondylolisthesis over a period of several years, noted an increase in the anterior displacement of the affected vertebral body varying from one-sixteenth to five-eighths-inch in five patients while under observation. He concluded: "The paucity of cases and the slight degree of increased slipping of the affected vertebra would tend to indicate that there is not a marked tendency for the deformity to increase."

Hitchcock,[6] in 1940, reported three cases in which the roentgenograms indicated progression from spondylolysis to spondylolisthesis. Two of these were in children and one in an adult. He states: "The roentgenograms of these cases present examples of spondylolisthesis in which may be found undoubted objective evidence of progressive forward migration of the vertebral column. . . . In all of these cases progression of the listhesis was accompanied in greater or lesser degree by roentgenographic evidence of thinning of the related intervertebral disk. This is a feature in spondylolisthesis which must be regarded as of considerable importance not only in the development of the listhesis itself, but also in the development of an osseous barrier to hinder further progression of the slipping."

Although George and Hitchcock's observations contradict the theory that slipping does not occur, they confirm Friberg's statement that it prob-

ably seldom occurs in adult life and the exact age at which the major displacement takes place has not yet been established. It can be said, however, that slipping and further displacement probably do not cause the symptoms of which the patient complains. The progressive narrowing of the intervertebral disk with degenerative changes in the disk and proliferative changes of the bone in the neighborhood of the intervertebral foramen may readily explain all of the symptoms and signs generally seen in spondylolisthesis (Fig. 3).

Treatment.—Treatment of spondylolisthesis, hitherto, has been directed toward improving the support of the lumbosacral portion of the spine. This is based upon the assumption that such support should provide relief by taking the stretch and strain off the ligaments and muscles and reducing the possibility of progressive slipping and displacement of the vertebra.

FIG. 3.—Roentgenograms illustrating narrowing of the intervertebral disk, impingement of bony surfaces and early associated arthritic changes which might produce symptoms of spondylolisthesis.

Conservative Treatment.—Results of conservative treatment as reported by various authors are admittedly poorer than the best results obtained by operative fusions; nevertheless, when well directed conservative measures have been carried out consistently, the degree of improvement has been considerable. Furthermore, it seems probable that even better results could be obtained if surgeons themselves gave more thought and attention to planning and directing such measures.

Of the 26 patients in my series treated with a brace or corset, 23 were followed from 10 to 18 months. Those who reported that they were relieved of pain while wearing the support and were able to perform light work with the help of the support were considered as having a good result. Those who obtained partial relief from pain and were unable to carry on light work regularly without aggravating the symptoms were considered to have fair results. Those with no relief of symptoms and unable to do any work

were classified as poor results. Seven of the 23 patients had good results, 12 fair and four poor (Table IV).

TABLE IV

RESULTS OF TREATMENT

Results	Conservative (Braces and Corsets) Observed 11-23 Mos.
Good	7 (31%)
Fair	12 (50%)
Poor	4 (19%)
Total	23 (100%)

The results obtained in those treated by conservative measures depended to a great extent on the cooperation of the patient. Those who wore the brace consistently usually found it possible to carry on any activities consistent with wearing the brace. Hardly any of them could lift objects or stoop over. The majority complained of the discomfort caused by the support and found it possible to get enough relief from rest and restricted activities. They preferred to follow this routine rather than to undergo operation or wear the support continuously. In many cases when the patient had overtaxed his back, he discovered that he could get relief by wearing the support for a few days and then discarding it. Approximately 80 per cent were, therefore, materially improved by the conservative treatment.

In only one or two cases did the patient carry out weight-reducing regimens with postural exercises and physical therapy, but in these cases the results were excellent and they were able to do active work including a moderate amount of bending and lifting without wearing a support. Men doing heavy labor usually found it necessary to change to a lighter occupation, which they were able to perform without wearing a support most of the time.

Although this series of cases treated conservatively is admittedly small in comparison with those of Meyerding,[8] Friberg,[1] and George,[6] the trend of results of treatment is similar to the results of a large series of cases reported by Friberg, who obtained good results in 80.3 per cent of cases.

Operative Treatment.—The assumption that progressive slipping occurs and that the severity of symptoms depends on the amount of displacement suggested that if a sufficiently strong bony bridge could be established from the sacrum to the third and fourth lumbar vertebrae posteriorly, it would serve to prevent further displacement and alleviate the pain. Spinal fusion operations of various types have been carried out by many surgeons over a period of years with a report of a high percentage of complete relief from symptoms (George,[5] 81.3 per cent; Friberg,[1] 81.8 per cent). Others, notably Meyerding,[8] and Chandler,[9] imply a high percentage of cases completely relieved by the operation although followed only for a short time. It is interesting to note that in all series of surgical cases reported some patients failed to obtain complete relief despite roentgenologic evidence of solid fusion postoperatively. On the other hand, failure of fusion occurred in

20 to 25 per cent of cases, and of these, a number was completely relieved of symptoms, although the operative procedure was a failure.

Most authorities agree with George, who says, ". . . when the pain becomes so severe that the sufferer demands relief not obtained by conservative methods of treatment the operation is definitely indicated." The preference for operative treatment of spondylolisthesis is based upon the assumptions that (1) progressive slipping does occur; (2) symptoms are the result of progressive slipping; (3) spinal fusion prevents slipping and thereby relieves the symptoms; and (4) bracing, corseting and physical therapy are not adequate to check slipping and hence do not relieve symptoms.

Friberg, in contrast, believes that, ". . . the conclusion must be drawn that there is no slipping of either the spondylolytic or the olisthetic vertebra during adult life. . . . This observation must change our attitude toward the question of operation."

In my series, spinal fusion was performed upon eight patients. They were observed from ten to 23 months; in three, the results were good, in one, a fair result was obtained, but in four, fusion failed to occur and the results were indifferent (Table V). Failure of fusion in the operative

TABLE V

RESULTS OF TREATMENT

Results	Lumbosacral Spinal Fusion Observed 10-23 Mos.
Good	3 (40%)
Fair	1 (10%)
Poor	4 (50%)
Total	8 (100%)

cases was undoubtedly due to errors in technic in some and perhaps to inadequate postoperative support in others. One patient whose operation was a failure has been subjected to a second operation in which the clothespin-type of graft, suggested by Bosworth,[7] was employed. Those who obtained poor results are wearing a support, corset or brace part of the time which enables them to perform light occupations.

SPONDYLOLISTHESIS ASSOCIATED WITH SCIATIC PAIN

In 1941, Meyerding[8] reported a series of 80 cases of spondylolisthesis associated with sciatic pain; 49 (61.3 per cent) had conservative treatment, 25 (31.3 per cent) had surgical fusion alone, and in six (7.5 per cent) surgical fusion was combined with removal of an intervertebral disk. Meyerding believes that in cases of sciatic pain and spondylolisthesis, it is best to combine removal of the protruded disk with lumbosacral fusion. In my series there was one case which suggests that associated sciatic pain may arise from another cause, *viz.*, involvement of the nerve root in proliferated bone.

Case Report.—Spondylolisthesis with Incarcerated Nerve Root. One of the patients who obtained no relief from the use of a brace was E. S., male, age 56. For three months following an automobile accident in 1936 he complained of low back and sciatic pain on

the left side. The sciatica disappeared spontaneously and he had nothing more than mild stiffness and soreness of the low back until October, 1942, when he noted a gradual onset of sciatic pain on the right side, which was constant and severe, aggravated by standing or by stooping but always relieved by lying down.

When the patient was first seen in March, 1943, the sciatic pain was severe enough to cause him to limp. There was no trunk list, the lumbar curve was normal and tenderness was present in the midline over the spinous process of the fifth lumbar vertebra. The sciatic pain could be aggravated or reproduced by bending movements and straight leg-raising. Reflexes at the knee and ankle were normal and there was no muscular weakness. Roentgenograms revealed a narrow lumbosacral disk, bilateral neural arch defects and spondylolisthesis, Grade I.

The patient was referred to the Department of Neurosurgery where the diagnosis, "disease of the fifth lumbar disk with compression of nerve root," was made by Dr. Dean H. Echols.

The patient was fitted with a brace, which he wore for three months without relief. He returned in May, 1943, at which time exploration of the spine was decided upon. Doctor Echols stated that he found the spinous process and lamina of the fifth lumbar vertebra loose and not connected with the body. Exposure was obtained by nibbling away the right lamina of the fifth and small portions of the laminae of the fourth lumbar and first sacral vertebrae. The first sacral nerve root was observed to leave the dural sac at an unusually low level. In order to expose the fifth lumbar nerve root it was necessary to use a chisel to remove the bone from the intervertebral foramen in which the nerve was incarcerated. It was finally exposed enough so that it could be lifted with a hook and pulled posteriorly. The remainder of Doctor Echol's operative note read: "At the end of the operation the fifth lumbar and first sacral nerves were fully exposed and freed. The fourth and fifth disks were not actually inspected. The fifth vertebra was dislocated anteriorly as shown by roentgen ray and the posterior lip of the first sacral vertebra produced the only intraspinal mass."

The postoperative course was without incident and the patient obtained immediate relief from the sciatica. Six months later he wrote that he had neither back pain nor sciatic pain, although he is extremely active.

This case proves that sciatic pain may be due to incarceration of the nerve root in proliferated bone in or about the foramen. It is evident, therefore, that protrusions from the intervertebral disk may not be the sole cause of sciatic symptoms. In cases such as the one reported it is unlikely that the sciatic pain would be relieved in either case by spinal fusion alone or by conservative treatment. This suggests that when spondylolisthesis is associated with sciatic pain and roentgenograms reveal a narrow lumbosacral disk with marginal hypertrophic changes, the nerve root should be explored and decompressed when necessary.

This review suggests the following considerations for speculation:

(1) Low back symptoms observed in patients with spondylolysis or spondylolisthesis are probably due to narrowing of the intervertebral disk and arthritic changes in the lumbosacral articulation rather than to progressive displacement of the spinal column with consequent drag upon the supporting ligaments.

(2) Symptoms produced by lumbosacral arthritis, especially in middle-aged persons not engaged in heavy laboring occupations can usually be adequately relieved by braces, corsets, physical therapy and postural exercises.

(3) Younger patients with similar symptoms producing greater dis-

ability may require operative treatment but it probably would be sufficient to fuse the lumbosacral articulation alone instead of attempting to bridge from the third lumbar vertebra to the sacrum with a bone graft.

(4) When sciatic pain is associated with spondylolisthesis, the nerve root should be explored and decompressed, either by liberating it from bony incarceration or by removal of a protruded intervertebral disk.

(5) It seems possible, from a theoretic viewpoint, that in certain cases the symptoms might best be relieved by removal of the attached neural arch and the inferior articular processes. Liberation of the nerve roots without fusion of the articulation or bridging of the defect with a bone graft should, of course, be supplemented by postural exercises and low back supports.

SUMMARY AND CONCLUSION

Fifty-nine cases of spondylolysis and spondylolisthesis have been reviewed from the viewpoint of diagnosis and treatment. This analysis suggests that probably a large percentage of patients with spondylolisthesis can be relieved by conservative measures and relief of symptoms in the remainder can be obtained by a simplified operation.

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9 Chandler, F. A.: Lesions of the Isthmus (Pars Interarticularis) of the Laminae of the Lower Lumbar Vertebrae and their Relation to Spondylolisthesis. Surg., Gynec. & Obst., **53**, 273–306, September, 1931.

DISCUSSION.—DR. FRANK P. STRICKLER, Louisville, Ky.: We are now seeing quite a few of these unfortunate patients who have had their nuclei pulposi, or disks, lifted. I do not know all about spines and low back pain, and I am equally confident that no one else has all the information on this subject. This problem has not been solved to date.

I would like to ask Doctor Dandy about some cases I have seen who have submitted to a number of operations—anywhere from two to five in some instances. I recall one woman who started with the removal of the fifth nucleus pulposus and progressed through a series extending up to the second lumbar. These operations were not all performed in the "Bush League" either. She had five operations in all—a most unusual patient! If removal of nuclei pulposi, or disks, cures these patients, she should be the most cured patient in the world, but this woman still has all her symptoms. She is a surgical derelict; her back looks as though a flock of woodpeckers and termites had worked on her and she had been topped off by a blast from a French "75."

Now let me tell you a little bedtime story to illustrate the point that all these cases are not what they seem to be. I was recently called in consultation to see a fairly

well-to-do lady who had low back pain. This patient had traveled around the country and had seen several neurosurgeons who had advised her to have an operation for the removal of the fifth nucleus pulposus, or disk, but for some reason she was not "sold" on the operation. I am a little oldfashioned, and I still believe that spine cases should have a carefully taken history, physical examination and the best of roentgenograms. In taking this lady's history I noted that her breath was reeking with liquor. I called her husband into an adjoining room and asked him how much liquor his wife was drinking daily. He said: "Oh, about a quart and a half a day." Now, I am from Kentucky, but I believe that a quart and a half is a little too much for the daily consumption of any one woman. I advised her family doctor to get this woman off her liquor. He finally did get her straightened out, after having one sweet time with her. The results were that her back cleared up completely and she has had no more low back pain; she has been well now for more than a year. Had that patient had a disk operation during her alcoholic saturation period, some surgeon would have had a very interesting time during her postoperative convalescence. As I have said, I do not know all about low back pain, so you can make your own diagnosis in this case.

In closing, let me say there must be more common sense used in treating these patients.

Dr. Ernest Sachs, St. Louis, Mo.: I would like to confine my remarks particularly to the presentation of Doctor Dandy. To listen to him, one would think the entire problem had not only been settled but was extremely simple. Those of us who have been interested in this subject and have had disks themselves, know it is not quite 98 per cent cures as he claims. In a recent article in the Annals of Surgery he says that diagnosis can now be made solely on the history of low back pain plus sciatica. It is not as simple as that, because there are other conditions which may give pain in the back, and although it may be true that pain in the back with sciatica may be due most frequently to dislocation of the disk, that is by no means the only cause. Spondylolisthesis, congenital defects, spinal tumors, *etc.*, must be considered. As Doctor Magnuson pointed out, a considerable number of patients with pain in the back and down the leg do not have a dislocated disk.

One of the most serious things, to my mind, is the statement made by Doctor Dandy in the above-mentioned article, and elsewhere, although he did not mention it tonight, that two-thirds of the cases that have these symptoms are due to a hidden disk. A hidden disk, as he illustrated very beautifully, is something anyone can produce if they cut the crucial ligament and curette out a little material. I always feel if I operate and do not get a good-sized disk that I have not reached the bottom of the trouble. I have seen some of these cases come back after months and years, one after seven years. I quite agree with him that one should not use contrast media; I quite agree that the spinal puncture ordinary should not be done.

I believe there is a wave of enthusiasm flooding the country and leading to operation for one of these so-called disks, and the operation itself may cause partial incapacity. Within the past two months I have had the opportunity of going to a postgraduate meeting in the West, just where I cannot mention for obvious reasons. I met the Commanding Officer who said they were discharging a number of men who had been operated upon for this reason, and who were incapacitated for army work; that of course does not mean incapacitated for ordinary civilian work.

Doctor Dandy makes the statement that frequently the postoperative symptoms and signs are due to hypertrophied ligamentum flavum, and that that is merely a self-satisfying explanation for negative findings. I believe it will not be so long before the term "ligamentum flavum" may be replaced by the phrase "hidden disk."

Dr. William A. Boyd, Columbia, S. C.: Far be it from me to pit my judgment against that of Doctor Dandy in the treatment of ruptured disk. However, I have seen a number of patients who supposedly had had ruptured intervertebral disks and had been operated upon, not only at Johns Hopkins, or elsewhere, but also in my own Clinic when we felt the symptoms justified the diagnosis; yet, after operation, the backache and sciatica continued. I think we must consider these cases more carefully and not get into a rut where we feel that every man with a backache or a pain in the leg when he sneezes has a ruptured disk. There are many other causes, as Doctor Magnuson has told you.

Just a word about Doctor Caldwell's paper: I do not think it is necessary to have

a complete displacement of the spine to make the diagnosis of spondylolisthesis. We have all seen patients on whom roentgenograms were taken standing and in the lateral plane, where no displacement of the spine was seen; yet after they start working backache comes on. I think we can consider many of these as cases of instability of the lumbosacral junction, or potential spondylolisthesis. I have had many patients with no evidence of anatomic displacement but all the symptoms of lumbosacral strain, and when a spinal fusion is done they get well. Let us not let our imagination run away with the idea that everyone has a ruptured intervertebral disk, or that everyone has a spondylolisthesis, but take each individual as he comes, find out what is the cause of his discomfort and disability, and treat him accordingly.

DR. CHARLES S. VENABLE, San Antonio, Texas: I am discussing the papers of Doctor Dandy and Doctor Magnuson jointly. I think there was a period, before there was this attempted definite diagnosis as described by both essayists, in which we had to make up our minds whether we would do a fusion or a decompression. In some instances, if we guessed right, we did a fusion and did well; in some instances we guessed wrong and got into a mess.

In the period of decompression we thought the thickened ligamentum flavum and the changed condition of the ligaments interspinously had to do with the pathology, so we did a decompression and the patient got well, so we proceeded to digress from fusions. As Doctor Caldwell said, frequently we were not able to differentiate these from spondylolisthesis, which I think is true today.

Then we came to the period around 1936, when somebody found a thing called a nucleus—a displaced disk. That was the period in which lipiodol and other funny things were injected into the spinal canal. I did some of these and many did badly; an operation was needed to remove the new pathology—lipiodol. So then we came along to the period in which it is specific that we must find a disk. Doctor Dandy told us two years ago that all low back pain plus sciatica was due to a ruptured disk. That was a very dangerous pronouncement to make. I question the wisdom of that and I question the physical findings.

I am going to digress and say that decompression, as we have gone along, has been clinically the answer in a large percentage of cases. As an illustration, take the Indian who never wore shoes and never had a corn. After he wore shoes and got an exostosis which was rubbed on by the shoe, he got a corn, and when he quit shoes he got rid of his corn. I am going to mention one patient, a young man, age 20, who came in because of a painful left sacro-iliac joint that was very severe. The reason I know it was the left sacro-iliac is because when he was eight years old he had had a nonsuppurative nontuberculous osteitis, with complete fusion of the right sacro-iliac, and we all know that if you have a fusion of one the other will be painful. I fused the left; in a year and a half he wrote that he had been getting alone fine, but now had to ride fences from 16 to 18 hours a day because he had not been able to get labor, and would that make any difference because he had developed pain in the back and thigh; I said it made a lot of difference.

He came in a few months later with a very severe low back pain and an exquisitely painful right sciatic nerve, with pain in the heel, *etc.* A diagnosis of herniated disk was made, and on exploration a nucleus the size of a pea was found anteriorly and to the right, between the fourth and fifth lumbar. With the cord pulled to one side this was easily visible, so two other surgeons working in other rooms were called to see it as I proposed deliberately not to remove it, but to close the wound in the usual way. The lamina of the fourth and fifth vertebrae had been removed. This man left the hospital on the tenth day without any artificial support, nor did he have either low back or sciatic pain. He is now back ranching and riding in New Mexico.

The Negro only cuts a piece out of the shoe for relief of a corn. I say to you that if there is pathology of the cartilage between the bodies you do not cure it by scraping it off with a chisel; harm may be done by that, while I believe it is the decompression that brings the relief.

DR. WALTER E. DANDY, Baltimore, Md. (closing): I appreciate Doctor Venable's frank comment. Two years ago when I said that the diagnosis was almost an absolute one, I realized that it was a very startling statement and one that would provide incredulity. I can only say that I would not dare make a statement of that kind

without incontrovertible evidence to sustain it. Two years later that statement stands *absolutely*. It is a perfectly simple, easy diagnosis, and needs no spinal injections. I certainly have no desire to make something sound easy if it is not.

Doctor Strickler's patient who had five disks removed is about as good an example as you would want of poor, bungling surgery. All I need say is—look at the surgeon who did it. I know full well how poor these results have been even in the best hands. Disks are recurring, sciaticas are recurring, backaches are recurring. But that need not be so if they are properly diagnosed and properly treated.

Doctor Sachs gave the impression that there was some discrepancy in what I said six months ago. I then said you could diagnose 95 per cent of cases by the history alone. I said tonight that you can diagnose 98 per cent with the history and the roentgenograms. You can diagnose at least 50 per cent by the roentgenograms alone—*i.e.*, by a narrowing of the intervertebral space, and this is pathognomonic of a defective disk. That is Nature's method of curing the disk, but it takes many, many years and may even then be unsuccessful, because the protrusion remains to cause the sciatica. I think you can tell by the history the difference between a large protruding disk and a concealed disk; they are fundamentally all the same but the large protruding disks have more continuous and more intense pain (sciatica) than the concealed ones. However, the treatment is precisely the same.

Although sufficient time has not passed to make a dogmatic statement concerning cures, I believe that when properly treated cures can be assured. I hold no brief for bad surgery.

Dr. Paul B. Magnuson, Chicago (closing): One of my relatives once said to me "You are always positive, and sometimes right." We all have opinions based on our personal experience, and my experience over a period of 35 years of dealing with the subject of immediate interest has convinced me, just as firmly as Doctor Dandy is convinced that he is right, that he is wrong. We are not going to convert each other tonight, but I think we have at least brought one question before this audience for its judgment; whether any one of you would like to submit to an operation for pain in the back accompanied by sciatica, without having had a thorough examination, without considering any other factors that might contribute to the pain, and take a chance on getting well; or, whether you would like to have the diagnosis based upon a complete examination, and have the operation suggested afterward if necessary.

SYMPOSIUM ON CHEMOTHERAPY

A REPORT ON THE HEALING OF WOUNDS AS INFLUENCED BY THE USE OF THE SULFONAMIDES AND COTTON THREAD SUTURES*

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CHARLESTON, W. VA.

USE OF SULFONAMIDES IN OPERATIVE WOUNDS

A GREAT DEAL of animal experimental work has been carried out with regard to the effects of the sulfonamides in wounds. Perhaps the most notable series has been conducted by Varco who performed 250 experimental stomach operations on dogs, covering a period of four years. These dogs were killed and the results noted from time to time. It was observed that when a suture line involving a hollow viscus had been dusted with sulfanilamide crystals union had been much more certain. He noted that when sulfonamide crystals had been dusted along the suture line, in every case there was found an unusually heavy deposit of fibrin which had firmly sealed the serosal surfaces at each suture line. Elsewhere the peritoneum was smooth and glistening. With such a mechanism for inhibiting bacterial growth locally, normal postoperative healing promptly took place.

Bartlett and Jones,[2] after extended studies on the healing of sterile and infected wounds in guinea-pigs, found that the use of sulfanilamide in a wound did not reduce the tensile strength of the scar, also that maximal saturation of the tissues with ascorbic acid markedly aided in providing optimal tissue healing and resistance to infection.

Animal operative surgery carried out in contaminated wounds by Lord, and associates,[3] showed that the most satisfactory healing of wounds and the greatest number of successful blood vessel anastomoses that were made in contaminated cases, resulted from the combined use of sulfathiazole orally and sulfanilamide locally after careful débridement had been done.

Paracelsus[4] said that in the final analysis it is the mustering defensive forces of the body which repel the invader and repair the damage. Since the sulfonamids are bacteriostatic and are thus able, for a while at least, to restrain toxic activity it seems obvious that they should be used with the hope of lessening the incidence of wound infection.

Key[5] expresses the opinion that the local implantation of sulfonamide powder in clean operative wounds is a safe procedure and definitely lowers the incidence of operative infections. He reports that in over 600 consecutive cases (elective operations) there were no toxic symptoms, except

*Read before the Southern Surgical Association, December 7–9, 1943, New Orleans, La.

fever, which occurred in about 5 per cent of the cases and may or may not have been caused by the drug. In these cases the total postoperative complications were three deaths, seven hematomas, one separation of wound margins, and four mild infections, two of which developed late. In the other cases the wounds healed in a normal manner without excessive scar formation and, in his opinion, the average period of hospitalization was shortened by the use of the drug. He uses sulfanilamide or sulfathiazole powder or crystals, or a mixture of the two drugs.

Loria[6] in his analysis of 100 consecutive cases of gun shot wound of the abdomen treated operatively, states that 49 received chemotherapy and of these 18 per cent died, while of 51 cases treated without chemotherapy 51 per cent died.

Quoting from a recently published article by Evans and Hoover[7]: "In Doctor Bigger's clinic at the hospital of the Medical College of Virginia, sulfanilamide has been used locally in several thousand wounds since 1938. All of us there are now absolutely convinced of the wisdom of this treatment."

Not long after he began the use of sulfanilamide in wounds, Doctor Bigger, during a visit to Charleston, told us of his very satisfactory experiences with sulfanilamide. We began using it in operative and other wounds and later combined it with sulfathiazole. Our practice has been to use both sulfanilamide and sulfathiazole in all wounds whether contaminated or not. The amounts used usually have been small, from 1 to 3 Gm. in the average abdominal incision. In practice we have found that the crystalline forms of sulfanilamide and sulfathiazole are less likely to cake and are more soluble than either the powder or the granular form. It is believed that the crystalline forms, when used in serous cavities, as in the abdomen or chest, diffuse more readily and are less likely to promote the formation of adhesions than the powdered forms of these drugs. On the other hand, when the necessity to control oozing arises as in bleeding from bone, powdered sulfathiazole firmly pressed against the oozing point, will usually stop the bleeding in a short time and may take the place of bone wax very well. Sulfanilamide is usually completely absorbed from a wound inside of 48 hours whereas sulfathiazole, being more slowly soluble, may persist for several days.

When ecchymoses occur about an operative incision following the implantation of sulfa drugs in a wound they are usually due to the fact that too much of the drug was used. Our use of these drugs has been to sprinkle them lightly throughout the wound and to spread them smoothly and evenly over the wound surfaces. When used in moderation and evenly spread we have been unable to detect any actual delay in healing.

The editorial board of The American Academy of Orthopaedic Surgeons in a review of progress in orthopedic surgery for 1942 mention the observations of Bick and Pheasant[8] which are to the effect that as long as small amounts of sulfanilamide compounds were used and also as long as the drug was implanted deeply in the wound that neither delay in healing nor delay in recovery of function of the joint was noted; that small doses were adequate

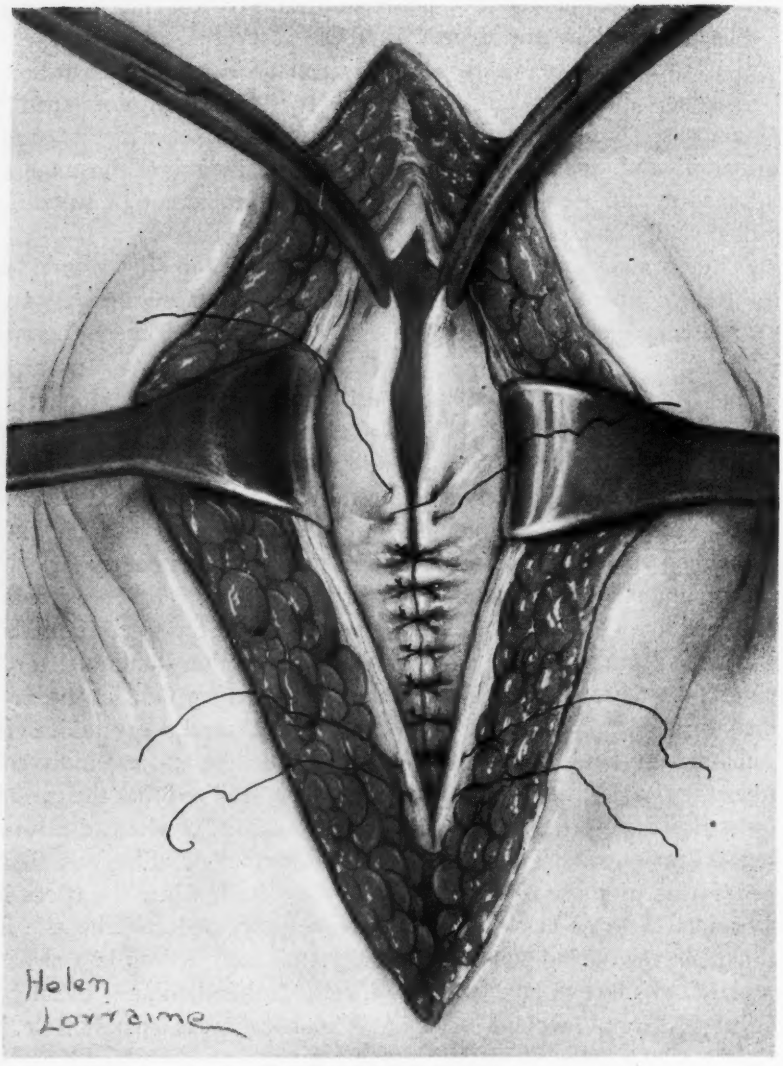

FIG. 1.—Closure of peritoneum and aponeurosis.

for the control of infection and did not cause reactions such as adhesions, fibrosis or other alterations in the joint. The editors further note that these conclusions confirm the observations now being made in hospitals of the armed forces all over the world.

In definitely contaminated abdominal cases we usually put sulfanilamide or sulfathiazole, as a rule not in excess of 6 or 8 Gm., in the abdominal cavity, placing both sulfanilamide and sulfathiazole in the operative wound as well. In chest wounds both the above mentioned drugs are used also. A moderate amount of sulfanilamide is routinely placed in all open wounds as soon as possible after admission to the hospital.

Our patients are given oral or intravenous sulfonamide medication either preoperatively or postoperatively as seems to be indicated; we feel that this is

in no wise incompatible with the local use of sulfanilamide compounds and that the two different methods can be made to supplement each other to the patient's advantage in many cases.

THE USE OF COTTON THREAD SUTURES

In the search for new and better materials it seems that we not infrequently wander far afield when what is wanted is at our door.

My attention was called to Dr. Alton Ochsner's[9] first report on the clinical use of cotton thread sutures soon after it appeared in the Journal of the American Medical Association for December 16, 1939. We began using that type of suture soon afterward and have used it exclusively since that time.

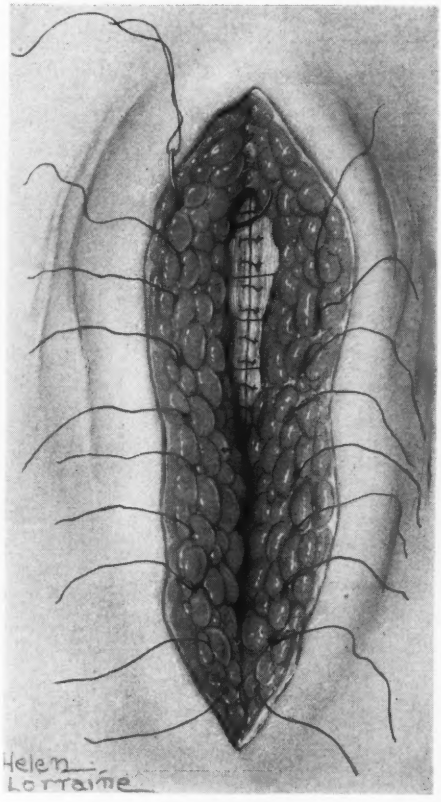

FIG. 2.—Closure of aponeurosis and subcutaneous fat.

Among the important articles that have been published advocating the use of cotton thread as suture material are those of Meade and Ochsner,[10] Meade and Long,[11] Sparkman and Williams[12] Hinton and Localio,[13] Taylor,[14] Nelson and Collins,[15] also Thorek.[16] Likewise Gage,[17] Foss,[18] Crile,[19] Horsley[20] and others, have advocated the use of cotton thread sutures.

Meade and Ochsner[21] showed that while unsterilized cotton has not quite the tensile strength of silk of equivalent size, after sterilization of cotton by boiling, there is an 11 per cent increase in its tensile strength, compared with only 4 per cent increase in silk. In their experimental work on animals it was found that there were moderate inflammatory reactions in the cutaneous tissues about both plain and chromic catgut, the latter somewhat more pronounced than the former. The edema was much greater than that surrounding either silk or cotton sutures.

They emphasize the disadvantages of catgut, in that the preservatives used in preparation of catgut are deterrents to wound healing, that they produce a local inflammatory reaction characterized by increased exudation bringing about what Gage[22] has termed a wet-type of healing, whereas silk, linen and cotton produce but slight inflammatory reaction and result in a dry-type of healing associated with early fibroblastic proliferation.

Meade and Long[23] hold to the technic laid down by Kocher,[24] and later

emphasized by Halsted,[25] in regard to the use of suture material, such as the use of finer suture material and the obliteration of dead space, also, that the combined use of absorbable and nonabsorbable material should be avoided. Apparently the compact structure of cotton prevents the ingrowth of tissue and lessens the incidence of suture sinuses which are rather common with the use of silk, particularly when used in superficial locations. It has long been known that the formation of sinuses incidental to the use of silk is much more frequent with continuous than with interrupted sutures, probably because infections are able to traverse the entire length of a wound along the tract formed by a continuous suture.

Microscopic Reactions.—Chromic Catgut: Marked leukocytic reaction extended deep in the muscle and fascia. *Plain Catgut:* There were marked leukocytic and serum reactions in all the tissue layers without penetration of the suture. *Fine Silk:* Moderate leukocytic reaction extending from the surrounding tissue into the interstices of the suture, the fibers of which were considerably separated. Moderate amount of fibrin present. *Fine Cotton:* Moderate leukocytic reaction in the surrounding tissue with an occasional leukocyte in the peripheral interstices of the suture. The reaction in the dermis was slightly greater than that in the muscle and fascia. Little evidence of serum. No fibrin.

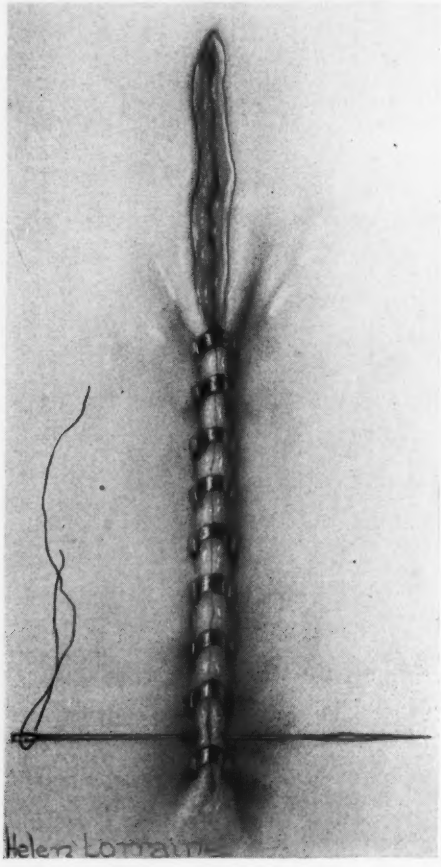

FIG. 3.—Closure of skin.

When wounds were closed with cotton, tissue reaction was least and the appearance of the fibroblasts was earlier (fibroblastic proliferation was evident a little earlier in wounds closed with cotton than with silk). Whereas all inflammatory reaction had entirely subsided in 13 days in silk-closed wounds, inflammatory reaction had disappeared as early as ten days in wounds closed with cotton. It is generally assumed that nonabsorbable sutures produce minimal tissue reaction and, therefore, are preferable to absorbable ones. This assumption has been substantiated by investigations with silk and cotton. On the other hand, linen, which has been used surgically for a much longer period of time, produces a much greater reaction than either silk or cotton, and up until the fifth day produces almost as great a reaction as catgut. This continues to diminish until the end of the tenth day.

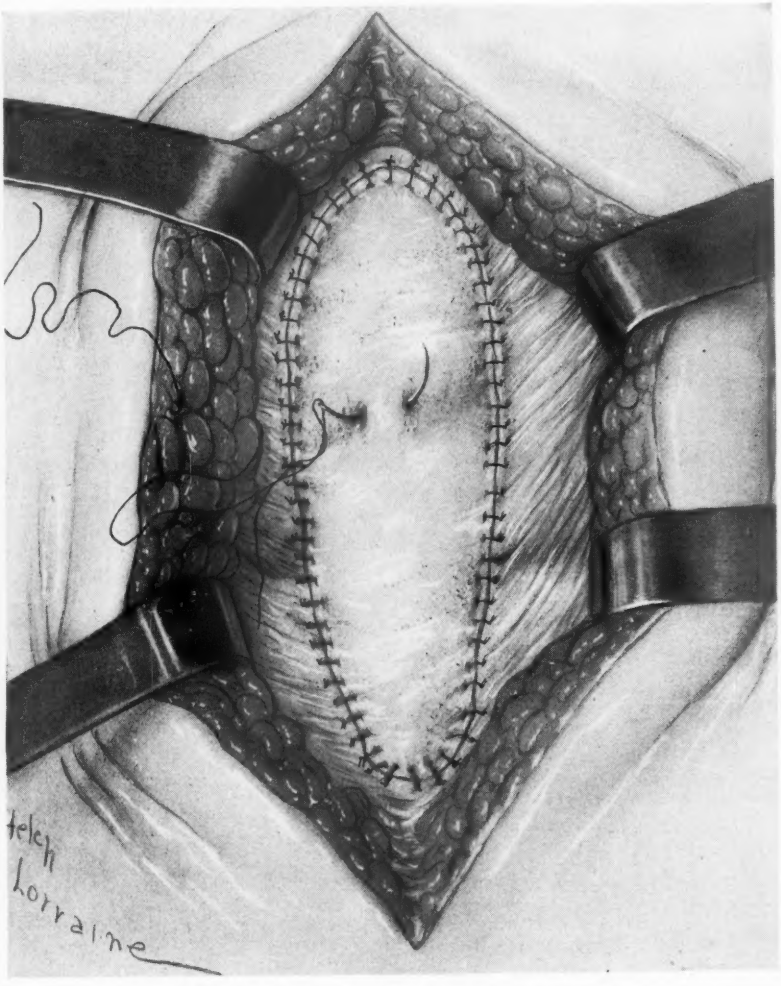

FIG. 4.—Closure of subcutaneous fat when cutis graft is used.

Meade and Ochsner[26] recommend cotton as an inexpensive, pliable, easily sterilized suture material. Due to its high coefficient of friction, cotton is not likely to slip after the first throw of a square knot. Furthermore, it can be tied with reliable square knots. After implantation in a wound, catgut, silk, linen and cotton decrease in tensile strength in the order mentioned. They have graded suture materials with the following criteria in mind: Amount and persistence of leukocytic infiltration; amount of serum and fibrin; appearance time of fibroblasts; and the length of time necessary to produce final healing. Wounds sutured with cotton showed the least reaction and healed in a shorter length of time.

In the research department of Temple University Medical School extended studies have been made by Large, and his associates,[27] in regard to the relative values of suture materials. Their findings are that among ordinary suture materials the tolerance of the tissues to sutures is in accordance with the

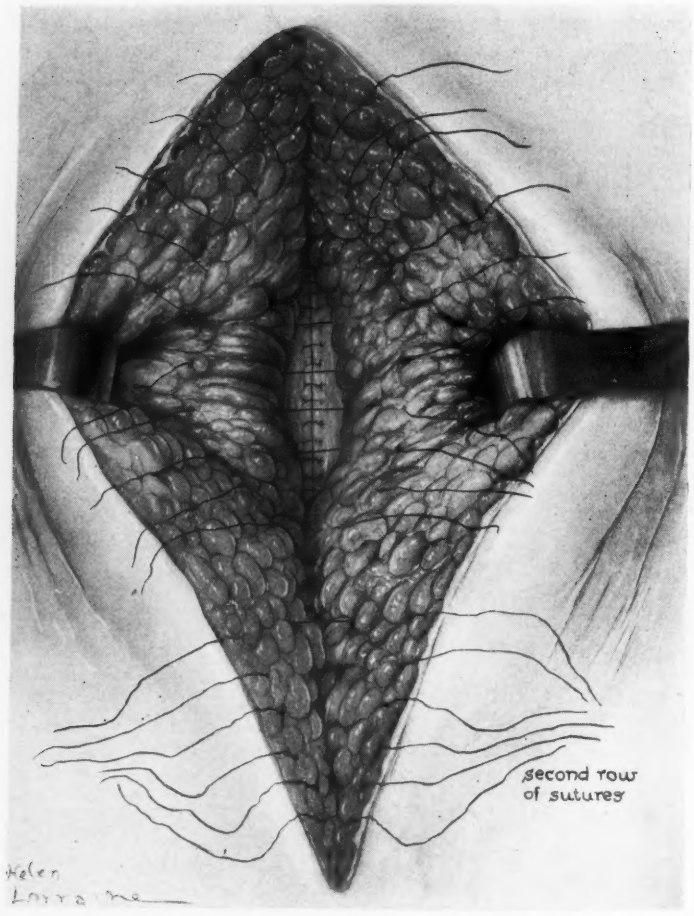

FIG. 5.—Closure of subcutaneous fat in very obese patient.

following listing: Fine, stainless steel wire, cotton thread, silk, plastigut, nylon, and catgut. Quoting Halsted he says: "The merits of sutures should be based upon their reactivity in tissues, wound strength and ease with which they can be handled." He further states that sutures causing the least reaction facilitate wound healing by reducing the inflammatory changes incidental to healing. He also notes that catgut, which causes the greatest reaction, is still the suture of choice, but that the surgical trend of today is changing toward nonirritating types of suture.

Hinton and Localio[28] state that various objections have been raised against the use of catgut. Among the more important of these are difficulty of sterilization, allergic sensitivity, variable absorbability, deleterious effects of chemicals, such as the production of serum, delayed fibroblastic activity, and delayed wound healing. Other well-founded criticisms are increased incidence of wound infection, wound disruption, postoperative hernia, and unreliability of the square knot tied with catgut. Silk is unquestionably an

excellent suture material. However, it has come into disrepute with some surgeons because slowly healing sinuses occur if infection develops. They state that cotton shows less tendency for tissue ingrowth between its fibers, and, hence, is less likely to produce sinuses in the presence of infection. Cotton, therefore, partially obviates some of the more serious objections to the use of nonabsorbable sutures.

Buxton and White[29] in their study of wound healing in 809 consecutive thoracoplasty stages performed on 195 patients from January, 1940, to January, 1942, closed the incisions with catgut in 538 cases and with silk in 271 cases. Of the thoracoplasty wounds closed with catgut 102 developed various abnormalities of wound healing, an incidence of 18.9 per cent, whereas only 19 or 7.0 per cent of the 271 wounds closed with silk developed some complication.

Skin Preparation.[30]—In preparation of the skin we have used iodine and alcohol.

After the peritoneal closure has been made most of our incisions have been irrigated with saline, with a view to the removal of at least some of the air-borne bacteria and other contamination.

Technic.—Nelson and Collins[31] have emphasized the need for greater exactness of technic, the avoidance of mass ligation with heavy suture material, *etc.*, also, the advantages of using fine cotton sutures such as Nos. 80 and 120, particularly for plastic work.

It has been observed from time to time that quite a few of the beginners in the use of cotton thread sutures in surgery are having the occasional formation of sinuses followed by the extrusion of sutures. These untoward happenings are almost always the result of improper technic, such as the use of sutures that are too heavy or the use of heavy sutures in the wrong location, *i.e.*, too near the skin, failure to close dead space over the heavier sutures, *etc.* In our work the parietal peritoneum and posterior fascia are routinely closed with Nos. 30 or 40 cotton thread carried through twice and tied. The aponeurosis is usually closed with size No. 30 interrupted sutures spaced not over one-quarter-inch apart, oftentimes less.

The closure of the fat layer of the abdominal wall over this aponeurotic suture line is particularly stressed. This closure is usually made with size No. 100 cotton thread sutures spaced about one-half-inch apart. A fairly deep bite into the fat is made on either side. Parallel sutures are placed and tied after all sutures are in. These sutures to a marked degree tend to prevent the development of a wide-spreading incisional scar. Skin clips, placed about one-quarter-inch apart, are used for the skin, interrupted cotton thread sutures, usually size No. 100, each one taking a comparatively light bite of skin, are placed between each two clips with a straight needle. The suture line is dusted with sulfanilamide crystals before a dressing is applied. The skin clips are usually removed on the second postoperative day and the interrupted sutures in from ten days to two weeks after operation.

In closing operative wounds, particularly in obese subjects and more

especially with reference to closure of wounds after the repair of incisional and other large herniae, it is of the greatest importance to close the wound in such a manner as to have the fascial suture line snugly covered with fat so as to obliterate dead space. In very obese patients, it may be necessary to close the fat in two or more layers, all with fine sutures. Fat heals perfectly when sutured in this manner.

Ligations inside the abdominal cavity with heavy ligatures, such as are at times used by many surgeons, particularly in such operations as hysterectomy or stomach resections, can be safely duplicated with heavy cotton thread. These ligatures are quickly glazed over by peritoneum and apparently do not cause trouble later on.

One of the greatest satisfactions in the use of cotton thread sutures is the fact that we are enabled to make a strong closure of an incision, mainly by the use of subcutaneous sutures. To me it has been a particular satisfaction to get away from the old tension sutures that included skin and aponeurosis. Better looking scars are now obtained and a greatly lowered incidence of wound disruption and postoperative hernia. As a further indication of the confidence we have in our abdominal wound closures, unless the patient is extremely ill we routinely try to get our patients out of bed at least twice each day beginning on the day following operation. They are encouraged to sit in an easy chair as long as they wish, to walk about the room, to the toilet, *etc.* This not only improves their morale but speeds up their recovery to a marked degree.

We have found cotton thread sutures of the finer sizes, *e.g.*, Nos. 80 to 100, to be very useful in cystocele and rectocele repairs, the closure of vesicovaginal fistulas and likewise to be very satisfactory in open anastomoses and various other types of gastro-intestinal surgery. Still finer sizes, like No. 120, are useful in dealing with plastic procedures about the eyelids, lips and face.

Doctor Ochsner[32] has expressed the opinion that cotton thread is of particular value as suture and ligature material in the operation of thyroidectomy. Dr. Hugh Bailey[33] expresses the opinion that the use of this

TABLE I*

CLEAN WOUNDS, USING COTTON THREAD SUTURES, SULFANILAMIDE, SULFATHIAZOLE AND WOUND IRRIGATION

No. of Cases	No. of Infections	Percentage of Infections
1440	18	1.3%

TABLE II*

CONTAMINATED WOUNDS, USING COTTON THREAD SUTURES, SULFANILAMIDE, SULFATHIAZOLE AND WOUND IRRIGATION

No. of Cases	No. of Infections	Percentage of Infections
612	42	16%

*The cases listed have been compiled from the surgical services of Doctors Bankhead Banks, Hugh A. Bailey and myself. The writer wishes to acknowledge the excellent cooperation on the part of the surgical residents in the treatment of these cases and in the keeping of accurate records concerning wound healing.

material enables the surgeon to close many thyroidectomy incisions without drainage. It is the writer's firm conviction that cotton thread suture material, properly used, will give superior results in all types of surgery.

A brief summary of a consecutive series of major surgical operations done by myself and surgical associates during the past three years in which cotton thread sutures, sulfanilamide and sulfathiazole have been used is submitted (Tables I and II).

The general run of our surgical cases has been mainly abdominal and gynecologic, including hernia, incisional and inguinal types, all without recurrence so far as we have been able to determine, gastric and intestinal resections associated with several open anastomoses of the large bowel (through the courtesy of Sharp & Dohme the majority of these had the benefit of both preliminary and postoperative succinyl sulfathiazole), ulcer perforations, *etc.* Virtually none of the contaminated or other cases, excepting leaking gallbladder cases, also a few toxic thyroid cases, have been drained. There have been six hematomas; one incisional hernia has been observed recently in one of our cases operated upon about one year ago (no doubt there are others but we have not been able to locate them); four wound disruptions—three of them contaminated cases—(one of these died several days after a secondary closure). The so-called anatomic types of incisions have been favored when practicable. The infections that occurred in the clean cases have been almost without exception of a delayed type, mild in character, and followed by satisfactory wound healing.

SUMMARY

As a result of extended clinical trial it is felt that wound healing is not interfered with by the conservative local use of the sulfonamides. In my opinion, the use of sulfonamides in wounds gives the surgeon an increased assurance of a lowered incidence of operative infection; it is believed that most of the infections occurring in contaminated cases will be less severe than might otherwise have been expected.

A tabulation of results with regard to healing of wounds in which the sulfonamides and cotton thread sutures have been used is given. It has been found that when cotton suture material has been used in accordance with an approved silk technic the results have been very satisfactory, also, that with the use of fine cotton sutures contaminated wounds usually heal without subsequent sinus formation.

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DISCUSSION.—DR. JOHN E. CANNADAY, Charleston, W. Va.: Speaking of stainless steel wire sutures, this type of suture is unquestionably more troublesome to place than the other types of permanent sutures in general use by surgeons. It very definitely constitutes a foreign body to a far greater degree than either cotton or silk. Apparently well authenticated reports would indicate that even buried stainless steel wire sutures may at times be the cause of considerable annoyance to the patient.

In regard to our various friends who want to stick to catgut, they do so out of habit or because it is the easiest way even though the ultimate results may not be all that might be desired. I have had considerable experience with catgut, silk, linen, but was never entirely satisfied with any one of them. I have found cotton to be a very satisfactory suture. I will admit that it takes more time to suture a wound with cotton than with catgut.

THE CHEMOTHERAPY OF INTRACRANIAL INFECTIONS*

OBSERVATIONS ON THE USE OF THE SULFONAMIDES AND OF PENICILLIN UNDER VARIOUS EXPERIMENTAL INTRACRANIAL CONDITIONS

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DURING the past two years, nearly 700 experiments dealing with the effects of various chemotherapeutic agents upon the normal brain and in intracranial infections have been carried out in our laboratory, by Drs. William F. Meacham, Ralph Angelucci, Edmund Benz, Thomas J. Holbrook and myself. A great many have been, or are being, reported in detail elsewhere. Some have proved fruitless. In all of these experiments, determinations of drug levels in blood and cerebrospinal fluid, cultures of blood and cerebrospinal fluid, histologic study by as many as eight staining technics, as well as clinical observations, have been made. It is our purpose in this paper to summarize some of the significant findings in these studies but space will not permit inclusion of many pertinent observations.

A—THE SULFONAMIDES

I—The Effects of the Sulfonamides when Applied to the Normal Dog's Brain:[1, 2] Sulfanilamide, sulfathiazole and sulfadiazine were placed upon the cerebral cortex in varying amounts. The drugs proved invariably to be irritating, but no serious clinical effects were observed except with sulfathiazole. The latter produced violent and often fatal convulsive seizures. The frequency and severity of the attacks were roughly proportional to the dose of the drug. All of the drugs produced marked irritative and destructive phenomena in the cerebrum and its membranes. Fibrosis in the meninges, acute leptomeningitis, subcortical hemorrhage, gliosis, metamorphosis of microglia and degeneration of neurones were the most striking changes. These alterations were greatest with sulfathiazole and least marked with sulfanilamide.

A microcrystalline suspension of sulfathiazole, when injected into the

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The sulfathiazole was supplied by E. R. Squibb and Sons, New Brunswick, New Jersey; the sulfadiazine by Lederle Laboratories, Inc., Pearl River, New York; and the microcrystalline sulfathiazole and sulfadiazine by Smith, Kline and French, Philadelphia. The penicillin was furnished by E. R. Squibb and Sons, and by Charles Pfizer, Inc., New York, on recommendation of the Committee on Chemotherapeutic and other Agents of the National Research Council.

cisterna magna, resulted in rapidly fatal convulsions in nearly all animals. A similar preparation of sulfadiazine produced convulsions in only one of six dogs.

It was concluded that sulfathiazole should never be placed in contact with the brain and that sulfanilamide and sulfadiazine should be employed, if at all, only in small amounts and with a full realization of their irritative effects.

II—Experimental Staphylococcal Abscesses: A strain of *hemoyltic Staphylococcus aureus* known to be virulent for dogs was prepared in sealed ampoules which were then kept in a freezing chamber in order to provide cultures of identical virulence for all experiments. Intracerebral infections were produced in three different ways: By the injection of staphylococci in agar; by the insertion of a gelatin capsule containing the organisms; and by injection of organisms into a previously injected mass of sodium ricinoleate (by the method of Markley[3]).

The experiments were carried out in groups of 12 and were equally divided between treated and untreated animals. Various groups were treated with sulfathiazole or sulfadiazine administered orally at eight-hour intervals in such dosage as to maintain an adequate therapeutic blood level of the drug in all treated animals.

Although abscesses were produced in the majority of animals, the results were not invariably consistent. Furthermore, abscesses which became well encapsulated did not usually terminate fatally. When abscesses ruptured into the ventricle or the subarachnoid space, fatal results were, in reality, attributable to meningitis rather than to the abscess. For all of these reasons, mortality rates in these experiments are not statistically significant.

Careful histologic study failed to reveal any significant difference in cellular reactions between the treated and untreated animals. The incidence of encapsulation was about the same in the two groups.

III—Staphylococcal Meningitis: Injection of the same strain of staphylococci into the cisterna magna invariably produced a fulminating meningitis which usually* terminated fatally within eight hours, in control experiments.

The effects of oral administration of sulfathiazole were studied in 32 experiments, of oral administration of sulfadiazine in 36 experiments, and of intracisternal injection of a suspension of microcrystalline sulfadiazine in 36 experiments.

Therapy with sulfathiazole did not significantly influence the mortality rate in the three groups of experiments in which it was given. This was not surprising, in view of the relatively low concentration of sulfathiazole in the cerebrospinal fluid which it is possible to obtain by oral administration.[2]

On the other hand, in two of three groups, oral sulfadiazine therapy resulted in a definitely lower mortality rate as well as a longer survival time in experiments terminating fatally. In one group of 12 experiments three of the six treated dogs recovered and only one died within eight hours, whereas

* Even in these experiments, there was an occasional recovery or longer survival period.

five of the six control animals died within eight hours and the remaining dog died after 24 hours.

Intracisternal therapy with microcrystalline sulfadiazine seemed to be very slightly beneficial in two groups of experiments and possibly slightly harmful in a third group. At necropsy, a firm mass of the drug was found completely filling the cisterna magna and covering most of the base of the brain. None of the animals had convulsions. It is not believed that this method of therapy is clinically beneficial or safe.

IV—Open Cerebral Wounds Contaminated with Staphylococci: In an effort to simulate the early treatment of wartime cerebral wounds, other groups of experiments were done in which a button of bone was removed, the underlying cortex traumatized and contaminated with staphylococci, and left exposed for a period of one to two hours. Treatment was then instituted with local application of sulfathiazole or sulfadiazine (with or without subsequent systemic therapy) and the wound closed. Again experiments were done in groups of ten or 12, of which half were treated and half untreated.

Local application of sulfathiazole did not seem to produce beneficial results. Mortality rates, survival time (in fatal experiments), healing of soft tissue wounds and histologic findings were essentially the same in treated and untreated groups.

On the other hand, local application of sulfadiazine resulted in a lower mortality rate in the treated animals. The beneficial effects of treatment were externally evident in the prompt primary healing of the wounds in the treated groups, whereas the wounds of the untreated animals almost invariably disrupted and drained for long periods.

When local sulfadiazine therapy was supplemented by subsequent oral administration of the drug, the beneficial results were more striking. Fourteen of 18 treated dogs recovered, as compared with nine of 18 untreated animals, and the survival time in fatal experiments was longer when treatment was given in most cases.

V—Pneumococcal Meningitis: A virulent strain of Type I pneumococcus was prepared and frozen, as with the staphylococci previously described. Meningitis was produced by injection of saline suspensions of the organisms into the cisterna magna. The meningitis thus produced usually ran a slower course than did the staphylococcal meningitis. In control experiments, a thick, viscid, purulent exudate was produced and the infection usually terminated fatally in four or five days.

The effects of sulfadiazine administered orally have been determined in 12 experiments and others are in progress. So far, results indicate that sulfadiazine is distinctly beneficial.

B-PENICILLIN

I—Staphylococcal Meningitis:[4] It has been shown by Rammelkamp and Keefer[5, 6] that penicillin, when administered intravenously appears in the

cerebrospinal fluid in only very minute quantities. This was supported by the disappointing results of our experiments in which intravenous penicillin therapy had no significant effect in experimental staphylococcal meningitis.

For this reason, we tried the effects of injection of penicillin directly into the cerebrospinal fluid. In the normal animals, the drug produces a transitory irritative effect which may be quite severe with large doses, but which subsides rapidly without significant local or systemic injury. This observation was also made by Rammelkamp and Keefer[5, 6] in human subjects.

In experimental staphylococcal meningitis, such intrathecal penicillin therapy produced strikingly beneficial effects. Nine of the 16 treated animals survived, as contrasted with only one survival in 15 untreated dogs. These results were obtained with doses of penicillin now known to be far smaller than the optimum dosage.

II—Staphylococcal Abscesses: These lesions have been produced as previously described and have been treated with penicillin administered intrathecally and intravenously. Results are equivocal. They seem to indicate that the treatment diminishes the likelihood of development of meningitis, but has little or no effect upon encapsulated infections. Additional experiments are in progress.

III—Open Wounds Contaminated with Staphylococci: In this type of wound, produced as already described, penicillin has been employed locally as a spray. About one cubic centimeter of a solution containing 1000 Oxford units per cubic centimeter was sprayed upon the wound one to two hours after contamination. In some experiments additional intrathecal and intravenous treatment with penicillin was employed.

Early results of these experiments seem to indicate that local application of penicillin in high concentration to traumatized cerebral tissue may actually be harmful. The mortality rate was much higher in the treated animals. Additional experiments and histologic studies (as yet not complete) are necessary before final conclusions will be permissible. *A priori,* one might expect the acidity of the solution of penicillin* to be quite irritating.

IV—Pneumococcal Meningitis:[7] in this type of infection, due to the same strain of Type I pneumococcus as that previously employed, intrathecal penicillin, in only moderate doses,† produced markedly beneficial results. The mortality rate was lower and survival time in fatal experiments was longer in the treated groups. The cerebrospinal fluid, grossly purulent in all control animals, was strikingly clear, with relatively low cell count, in most of the treated dogs.

Some of the fatal results among the treated animals were found to be due to pneumococcal pneumonia. The mortality rate was still further reduced when intravenous as well as intrathecal administration of penicillin was employed.

* p_H 5.2 to 6.5, depending on the concentration.

† 100 to 200 units twice daily in dogs weighing seven to ten kilograms.

SUMMARY

The results of approximately 700 experiments have been summarized. The following significant findings have been emphasized:

1. Sulfanilamide, sulfadiazine, and sulfathiazole were irritating to the normal dog's brain, increasingly in the order given.

2. Sulfathiazole very frequently produced severe convulsions when applied to the brain, and should never be so employed.

3. Sulfanilamide and sulfadiazine, in small doses, may safely be used in the intracranial chamber.

4. Experimental cerebral staphylococcal abscesses were benefitted by oral sulfonamide therapy only insofar as their effects on secondary meningitis were beneficial.

5. Experimental staphylococcal meningitis was markedly benefitted by oral therapy with sulfadiazine but not with sulfathiazole.

6. Open wounds contaminated with staphylococci were benefitted by local application of sulfadiazine, but not of sulfathiazole.

7. Penicillin produced transitory meningeal irritation when injected intrathecally but may safely be given by that route in relatively large doses.

8. Intravenous penicillin therapy was ineffective in experimental staphylococcal meningitis but intrathecal penicillin therapy was markedly beneficial.

9. Penicillin, in strong concentration, may be harmful when applied directly to the brain.

10. Intrathecal penicillin therapy was of marked benefit in experimental pneumococcal meningitis.

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DISCUSSION.—DR. WALTER E. DANDY, Baltimore, Md.: Doctor Pilcher's paper is important and very timely. It is a fine example of the value of scientific approach to the solution of the problem, instead of floundering through trial and error. With the magic results one obtains from the use of the sulfa drugs and penicillin, one might be ready to accept the thought that the same would hold true for all expressions of infections. It is my experience from the clinical side, just as it is Doctor Pilcher's in his animal experiments, that none of these drugs have any appreciable effect when the infection becomes walled-off. Meningitis will clear in 24 hours, but the drug does not reach an encapsulated abscess.

Of particular interest is the adverse effect of the various drugs on brain tissue when treating open wounds. This is, of course, all important to the Army and Navy at the present time. Without these timely experiments by Doctor Pilcher we might well have floundered through, expecting that all these drugs would have only beneficial effects when used locally, and without serious sequelae. Precision is attainable only by test through experiments. I see no flaw in Doctor Pilcher's experimental studies. The results should be applied by the Army and Navy at once. There is an old maxim—"Be not the first to accept the new, nor be the last to throw the old aside." That holds here. Lives and serious after-effects can be spared by the experimental approach, of which this is a beautiful example.

MAJOR H. J. WARTHEN, JR., Richmond, Va.: I would like to comment on one thing. Doctor Cannaday emphasized the importance of adapting the technic of the surgeon to nonabsorbable sutures when these are used. This is not always realized by neophytes. They have read about the advantages of silk or cotton or steel wire, and they either do not read the entire article or it does not emphasize sufficiently that they cannot adopt nonabsorbable sutures without changing their former catgut technic. I think this is particularly true with the younger surgeons who enter the service. They feel they have broken with the old civilian practice and entering the service gives them an opportunity to break with some of the methods formerly used by them. Inasmuch as there has been so much in the literature in the past few years regarding cotton, silk and synthetic suture material, they feel it is a good opportunity to start using it. I am afraid many neglected to change their technic when they changed their suture material. This has meant that some draining sinuses have resulted and the nonabsorbable material must be extruded in many cases before the sinus heals. This is true of silk, cotton or steel wire, just as it is of any other foreign material. I am not saying this as a critic of cotton or silk, for I have used nonabsorbable sutures for the past 16 years, but I try to follow the dictums of Halsted, which are just as true now as they were 50 years ago. You cannot use cotton or silk with the old catgut technic. For this reason I was particularly pleased to hear Doctor Cannaday stress this point.

DR. CHARLES C. GREEN, Houston, Texas: The last time I appeared before you a lot of you thought I was joking, but I am not joking now. Shortly after World War I there was a very popular play in New York—"Fifty Million Frenchmen Can't Be Wrong"—and I think that applies in the use of nonabsorbable sutures. Too many men have used catgut and get good results to give up to a minority. Ochsner, and some others, say they are not progressive surgeons, but Ochsner has not had as much experience as I have, because I have lived a long time and I did not do as Doctor Dandy said—"Don't be the first to accept the new or the last to discard the old." I accepted the new and got into trouble, and I am back with the old catgut technic and I feel I get the best results that way.

With regard to the use of the sulfonamides: It has not been mentioned, but remember that sulfonilamide is the most soluble of the sulfonamines in body tissue. Many of us used sulfathiazole when it was at the height of popularity, with the result that later we found encapsulated crystals. That will not happen with sulfonilamide, and for that reason I feel it is good to use it as local treatment because it is soluble and will have its effect.

One more statement about sutures: I cannot see why, unless it is an economic problem, they should use cotton instead of linen. We are told we cannot use silk because of protein reaction, and I accept that. But you can tie linen much more easily than flimsy cotton when it gets wet. I really cannot see how it can be a permanent suture.

They say it absorbs, but I have had patients coming in with silk in them for years. I used it especially in hernia operations and I have picked things looking like mosquitoes out of the wound for months and months. I know Doctor Al is one of the best surgeons in America and I have seen him use little bits of silk in doing a pneumonectomy, and I would be scared to do that. One time when he was using little bits of silk he said—"What would you use?" and I said—"No. 3 chromic catgut."

DR. I. A. BIGGER, Richmond, Va.: So far as I know, the first person in Richmond to use the sulfonamides locally was the late Dr. Joseph Geisinger, a Fellow of this Association. I think that was in 1937 or 1938. I bring this out because Doctor Cannaday was kind enough to mention my name in this connection. Though not responsible for this method of using the drugs, I am convinced that the sulfonamides are effective when used locally in other parts of the body than the central nervous system. As Doctor Cannaday pointed out, the powder or crystals should be well distributed and not used in too large amounts in any area of a wound. A mixture of sulfanilamide and sulfathiazole is probably best because sulfathiazole tends to cake when used alone, and sulfanilamide is not effective against staphylococci. One must not use these drugs as a substitute for proper surgical measures in the treatment of contaminated wounds but as an adjunct to those measures. I think there is danger that younger surgeons may become careless in the management of contaminated wounds, depending upon the sulfa drugs to prevent infection. If this occurs they are almost certain to get into trouble.

I would like to stress the importance of the administration of the drug by mouth or vein 24 to 48 hours following the local application, and continuing for from five days to a week. These drugs when used only locally will, as a rule, prevent the development of fulminating infections, but infections may develop subsequently, coming on after two weeks or even later.

DR. BARNEY BROOKS, Nashville, Tenn.: I believe those discussing the use of the sulfa drugs in wounds should clearly state what sort of wounds they have in mind. I know of no evidence which has been disclosed which indicates the desirability of putting any antiseptic or bactericidal drug in a presumably clean operative wound. On the other hand, there is a great deal of evidence in Doctor Pilcher's paper that the sulfa drugs produce damage to healthy tissues.

DR. JOSEPH E. J. KING, New York City: I think Doctor Pilcher, and his coworkers, are to be congratulated. I should like to ask him two questions: The first, has he injected or instilled sulfanilamide solution or penicillin directly into a brain abscess; and, second; have any cases of brain abscess recovered by so doing without operation for abscess?

DR. WM. H. PRIOLEAU, Charleston, S. C.: A consideration of wound healing is not complete without some reference to the dressing. In this regard I would like to call attention to the fact that besides protecting the wound from contamination, an important but frequently neglected function of the dressing is that of wound splinting or soft tissue immobilization. A firmly applied voluminous elastic dressing serves to obliterate dead space, reduce exudation and capillary oozing, and also to hold firmly approximated the wound surfaces, making possible more ready union. This is particularly well demonstrated in the dressing of a skin graft. While of definite value in all clean wounds it is especially so in such as thyroidectomy and amputation wounds where the raw surface is unduly large. Rubber sponge incorporated in the dressing serves this purpose well. Dressing a wound in this manner effectively protects it from the development of complications.

DR. FRANK K. BOLAND, Atlanta, Ga.: I prefer sulfanilamide locally, and sulfathiazole internally, in infected or potentially infected wounds. I am also coming to like cotton sutures. I wish to show the slide of a skin suture I use in a large number of cases. After the operation the patient is not so much interested in the pathology we have uncovered as she is in how much it is going to hurt to take out the stitches. Her visitors have told her how much it will hurt. For this reason I have tried to evolve a method which will produce little pain. Dermal is used and no knots are tied; instead

I use a little lead perforated bead, such as is used in the obstetrical department to put around the baby's neck. The stitch is put in to evert the skin edge; if the incision is long it is done in sections. The bead is crushed here and suture made; then about the middle of the line of suture I put in an extra loop, the object of which is to enable one to pick up the suture and cut it. If this is not done, sometimes there is difficulty in finding the middle of the suture, because of swelling of the skin. This is lifted up slightly and nipped, and usually the ends can be pulled out easily. If it sticks a little I cut it and do not remove it for 24 hours. The patient is surprised and also disappointed. While she is looking forward to the pain she is expecting, the one stitch is out.

DR. ALTON OCHSNER, New Orleans, La.: I beg your indulgence for discussing another paper this morning, but since my No. 3 catgut, lariat-throwing friend from Texas has asked for it, I think it is necessary to give the reason why cotton and silk are preferable to linen. I felt at one time as Doctor Green does that linen should be the ideal procedure since Pagenstecher linen is advocated as a suture for ophthalmic surgery. In the investigation which Doctor Meade and I made, however, we found that linen produced almost as much reaction as did catgut, and it is for this reason that it should not be used.

Concerning the use of cotton, I have often made the statement that if I were told that I could use cotton in only one type of case I would choose to use it in the grossly contaminated abdominal wound. This statement is contrary to all the opinions concerning the use of nonabsorbable sutures; but the opinion is based upon our experience with cotton. Several years ago on our service at the Charity Hospital, we studied the incidence of complications in clean and contaminated wounds which had been closed by one of three suture materials—cotton, silk and catgut. This study was continued over a period of six months. Whereas there was not a great deal of difference in the clean wounds, there was considerable difference in the contaminated wounds. Those contaminated wounds which were closed with catgut all became infected. In the wounds closed with silk, 30 per cent healed by primary intention without any infection and 70 per cent became infected, whereas in the cotton-closed wounds, 48 per cent healed by primary intention and 52 per cent became infected. If one closes a grossly contaminated wound with catgut, wound disruption or herniation is likely to occur, as infection occurs in every instance. In the presence of infection, wound healing is definitely interfered with and fibroplasia does not become complete until the infection has subsided. Also, because of infection there is rapid absorption and digestion of the catgut so that there is a very definite period of time when nothing holds the wound edges except wound exudate. If, however, a contaminated wound is closed with cotton, according to our experience, one can expect primary healing without any evidence of infection in 48 per cent of instances. In the 52 per cent of cases in which infection does occur, there will be the same degree of interference with wound healing and fibroplasia will not be complete until the infection has completely subsided. In the meantime, however, the cotton holds the wound edges together so that wound rupture or herniation does not occur. In most of the cases which become infected even though cotton is present in the wound, healing occurs without the discharge of a single suture. In some instances a suture will become discharged, but this is a relatively cheap price to pay for the prevention of wound rupture and subsequent herniation. I prefer the use of cotton, because I think it is the ideal suture material available at the present time.

Incidentally, the cost is of interest, although this is not the reason I prefer it. We have estimated that the average cost per operation when catgut was used was $1.19; when silk was used, and in all fairness to silk it must be stated that this was surgical silk, it was $0.93; when cotton was used, which was purchased from that exclusive surgical supply house, Woolworth's, the cost was 1¼ cent. We estimated that at the Charity Hospital if everyone used catgut one year and then limited his use to cotton the next, there would be an annual saving of more than $9,000.

Doctor Horsley asked about the use of malleable steel. Malleable steel produces no reaction, but is somewhat more difficult to use and is radiopaque. I believe that cotton has all the advantages that malleable steel has without these two disadvantages.

DR. ALBERT O. SINGLETON, Galveston, Texas: It does little good to get a suture discussion going in a medical meeting, because everybody goes away of the same

opinion as when he came. I cannot refrain from stating that most of the trouble complained of is with wounds in the abdomen. I have contended for a long time that those who are having a lot of trouble with abdominal wounds are using unanatomic incisions. If more respect for the anatomy of the abdominal wall is kept in mind, and less thought for the suture material, difficulties will be lessened. If one cuts tissues across the line of tension, he will look for a long time to find proper suture material. By substituting muscle and fascial splitting incisions for the old vertical incisions it will make suture material a less serious problem. Circulation must be present for union of the tissues to occur. If it is necessary to use much tension to hold the surfaces together there will be interference with circulation. Therefore, I wish to make a plea for the serious regard for the anatomy of the abdominal wall as the solution for most suture material difficulties.

DR. JOHN E. CANNADAY, Charleston, W. Va. (closing): Speaking of stainless steel wire sutures, the wife of a physician in our state had a vesicovaginal fistula repair with steel wire sutures. She went home apparently entirely well, but later a local urologist removed from time to time a total of 30 or more stainless steel sutures through the urethra.

In regard to our various friends who want to stick to catgut, they do so out of habit or because it is the easiest way even though the ultimate results may not be all that might be desired. I have had considerable experience with catgut, silk and linen, but was never entirely satisfied. I have found cotton a very satisfactory suture. I will admit that it takes more time to suture a wound with cotton than with catgut.

DR. COBB PILCHER, Nashville, Tenn. (closing): I would like to thank Doctor Dandy for his very kind remarks. In answer to Doctor Green, or in connection with what he said, I am in full agreement that sulfonilamide is still a drug with a great deal of usefulness, not only because it is more highly soluble, but also because it is less irritating than any of the other sulfonamides.

Doctor King's question with regard to injecting drugs directly into an abscess cavity is beyond the scope of our work at present. We have not done this and I do not believe it is feasible under the experimental conditions I have reported.

CLINICAL AND LABORATORY EXPERIENCES WITH SUCCINYL SULFATHIAZOLE*

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The progressive improvement in mortality rates in large bowel surgery in recent years has paralleled the general improvement in mortality rates in all types of surgery. Although there have been, of course, specific technical innovations in various surgical fields that have been partially responsible for the generally lowered death rate of surgical operation, the major share of this decline has been due to a greater understanding of, and care for, the patient in whom disease exists. The recognition, measurement and replacement of water, carbohydrate, protein, electrolyte, vitamin and hemoglobin deficiencies and the general measures against spreading infection offered by chemotherapeutic resources are paramount in altering the degree of surgical risk. In each surgical field there are both general and specific technical measures that have particular importance.

In the field of large bowel surgery, the specific measures of chief importance have been directed against the risk of infection, both in the peritoneum and in the abdominal wall. In addition to aseptic technics of anastomosis, they have consisted of three major methods: (1) Stage operation; (2) attempts to decrease the bulk of bowel content; and (3) attempts to alter or decrease the number of the organisms in the fecal stream. Before the introduction of the first effective "intestinal antiseptic" by Firor and Poth, the third method has been based by certain surgeons on the principle that the pathogenic organisms in the bowel are largely proteolytic and that they can be decreased in number by denying them a protein pabulum.[1, 2, 3, 4] The so-called "colon preparation" diet consists of a nonresidue almost completely carbohydrate diet with vitamin supplements. With increasing knowledge of the rôle of protein in the surgical patient, it is obvious that this is by no means an adequate diet in the preparation of patients for major surgical procedures, particularly of patients with gastro-intestinal lesions who may already have depleted protein reserves from preceding relative protein starvation. It is also an exceedingly dull diet and, therefore, has a definite psychologic disadvantage. When first sulfanilylguanidine and later succinyl sulfathiazole were made available through the reports of Firor, and others[5, 6, 7, 11] it occurred to us that the new more direct method of attack on intestinal bacteria might offer the opportunity for providing a better balanced and more palatable diet to

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patients approaching operations on the colon and rectum without at the same time discarding the supposed advantage of the older technic. In the present study in addition to specific data bearing on this point, we present confirmation of Firor and Poth's general observations on succinyl sulfathiazole,[8, 9, 11] and the clinical results in a small series of cases of operation on the large bowel in which the drug has been applied.

METHODS

Stool Culture.—Specimens of stool, either fresh or promptly refrigerated after evacuation, were weighed and emulsified in appropriate dilutions. Plates of eosin-methylene blue agar were inoculated both by pouring and streaking and the number of colonies of *B. coli* and *B. aerogenes* were counted after adequate incubation. From this number in a known dilution, the number of colonies per gram of fresh stool could be calculated. This result was expressed in a logarithmic curve. These two organisms were chosen since they present distinctive colonies on the medium employed and offer an index of effect on organisms susceptible to succinyl sulfathiazole.

Blood Concentration.—The concentration of free and combined succinyl sulfathiazole in the blood, was determined by the method of Bratton and Marshall.[10]

Urine Output.—The amount of succinyl sulfathiazole in 24-hour specimens of urine was calculated in the same manner.

Diets.—Three types of diet were employed in various studies, namely: (1) Regular hospital diet. (2) A high carbohydrate, high protein, low residue diet with vitamin supplement. (3) The "colon preparation" diet consisting of clear liquids and stick candy, also with vitamin supplement.

RESULTS

Laboratory Studies.—Four healthy individuals, hospitalized for fracture or other disease not related to the gastro-intestinal tract, were first studied in an attempt to determine a base level of concentration of *B coli* and *B. aerogenes* in the stools. It early became apparent that the variations from day to day are enormous, as shown during the control periods in the two cases presented in Chart 1. For instance, one patient on a regular diet showed a decline in the number of these organisms within a 48-hour period from nearly 10^{10} per gram of stool to 10^{7}, a thousandfold difference. In spite of this fact, it was thought that perhaps an even greater decrease might occur following the administration of the "colon preparation" diet. Two cases were, therefore, placed on this diet for seven days, without apparent result (Chart 1). In neither case did the stool count fall as low as it had in the course of daily variations while on the regular hospital diet. Although the results in these two cases do not disprove earlier experimental work on animals and man[1, 2, 3, 4] they suggest that the effect of a low protein diet on the bacterial pattern of the stool must be uncertain within the limits of time available for the preparation of patients for surgery of the colon.

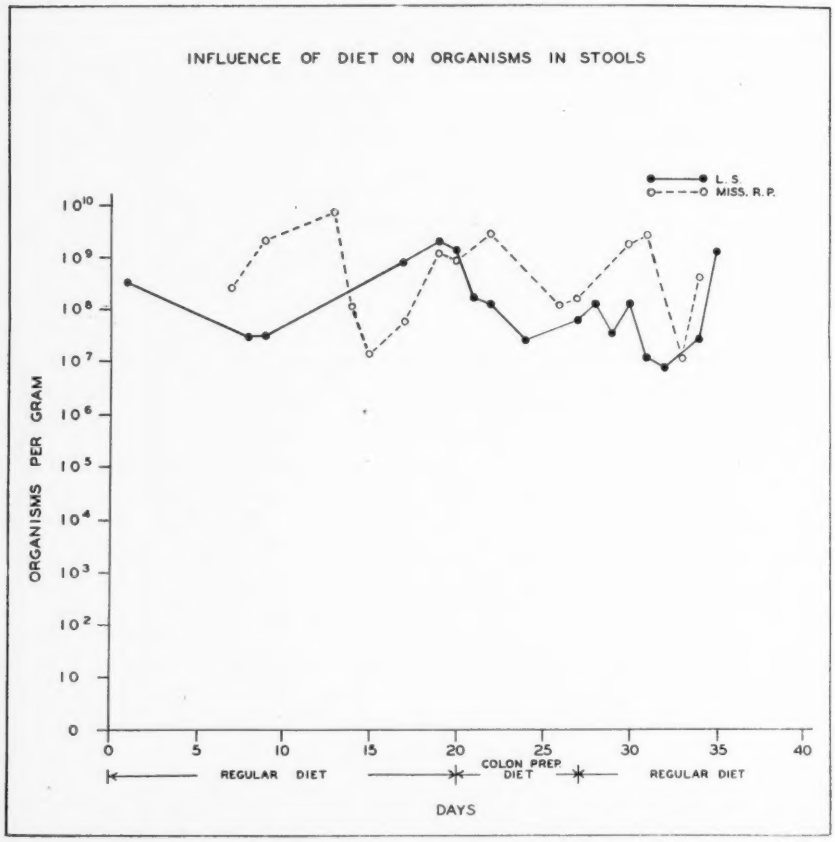

CHART 1.—Counts of B. coli and B. aerogenes in stools of two patients on regular and "colon preparation" diets. The curves are expressed logarithmically. Note that during the week of "colon preparation" diet, the stool counts did not fall as low as they did on regular diet. Note also that the variations on both diets are extreme.

The much more dramatic results of the administration of succinyl sulfathiazole as previously reported[8, 9, 11] led to a different approach. Sixteen patients, ten of whom had large bowel lesions and six of whom had none, were studied before and following the administration of succinyl sulfathiazole in the usual dosage.* In all cases there was a prompt drop within six days in the number of *B. coli* and *B. aerogenes* from a level in the order of millions or billions per gram of stool to less than 100, and in some cases to zero, even when the undiluted stool was cultured. The average time of reaching the level of 100 colonies or less was 4.8 days. When the cases that received the clear liquid and sugar diet were compared with those that received adequate protein, no significant difference in the rate or completeness of disappearance of the organisms occurred (Chart 2). The patients with protein in the diet actually present a curve of more rapid decline than those without; if this relatively slight difference can be explained, the reason may

* The succinyl sulfathiazole employed in the earlier portion of this study was furnished by courtesy of Sharp and Dohme.

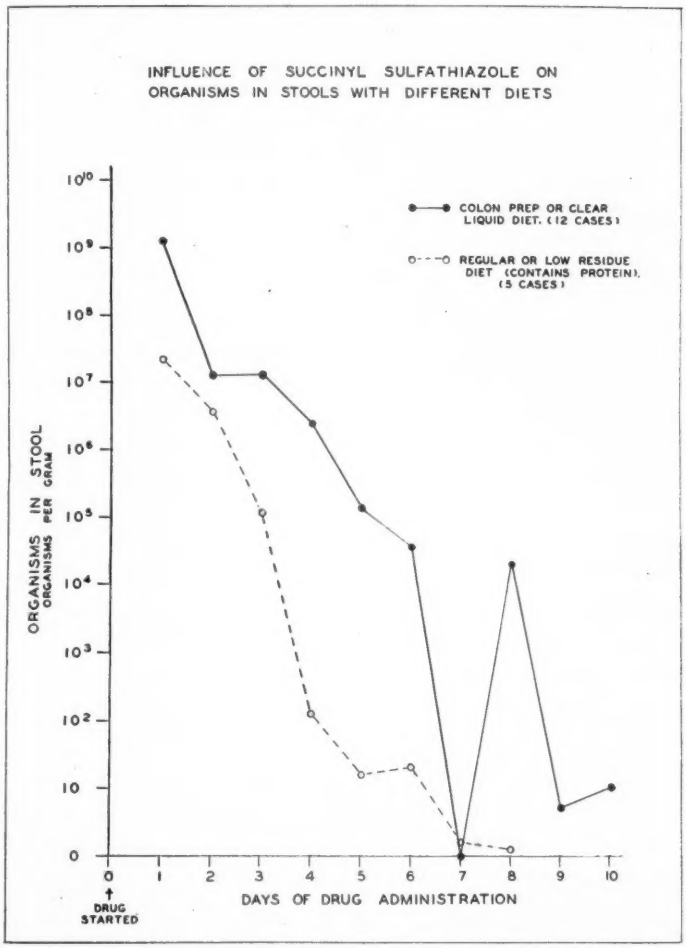

CHART 2.—Average counts of *B. coli* and *B. aerogenes* in stools of seventeen patients receiving succinyl sulfathiazole. Five of these patients were on "colon preparation" diet and twelve on regular or low residue diet containing adequate protein. One case received the drug for only three days and is, therefore, not included in the results of complete treatment recorded in sixteen cases in the text. Note that there is no significant difference between patients receiving differing diets.

lie in the fact that most of the patients on the low protein diet had large bowel lesions, usually ulcerated.

In 15 cases the blood concentration of the drug was studied every two or three days. In five cases, only a trace of succinyl sulfathiazole was present in the blood. In only one case did the blood level ever rise above 3 mg. per 100 cc. In that instance the concentration on one day was 5.9 mg. per 100 cc., falling to 2 mg. on the following day in spite of continued administration of the drug.

The total amount of succinyl sulfathiazole excreted in the urine was followed daily in 17 patients. The average amount excreted was 5.4 per cent of the amount ingested. The lowest amount was 1.3 per cent and the highest 11.1 per cent.

All patients receiving succinyl sulfathiazole both during the above experimental studies, and since, have been carefully watched for toxic manifestations as demonstrated in the blood picture, the urine, the temperature and pulse curve, the skin, and the psyche. The drug has been given to well over 45 individuals. In this number the only unfavorable occurrence was a hemorrhagic skin eruption which was seen in a patient who had previously received sulfathiazole. The rash did not progress while continuing the administration and cleared up promptly when the drug was withheld.

Clinical Cases.—Succinyl sulfathiazole has been given to 36 patients in preparation for operations in which the large bowel was divided or anastomosed at the primary operation. Several cases of exploratory celiotomy, first-stage colostomy, or other procedures not entailing possible contamination from the bowel lumen were prepared for operation by this method but are not included in the present summary. Sixteen of the cases had a low residue diet with adequate protein; 20 were on clear liquids and sugar. All had vitamin supplementation. In 24 cases the operation was carried out by aseptic methods; 12 cases had known peritoneal contamination either from preexisting infection, accidental perforation of the bowel, or open anastomosis.

Three of the 36 cases died in the hospital, a gross mortality of 8.3 per cent. In only one case, however, could the death be ascribed to failure of succinyl sulfathiazole; the corrected mortality is, therefore, 2.8 per cent. One patient, age 58, died of thrombosis of the middle cerebral artery on the twelfth day after combined abdominoperineal resection of the rectum for carcinoma. Postmortem examination revealed a cleanly healed wound and no peritonitis. A second patient, a woman, age 44, suffering from postoperative fecal fistula was operated upon as a last resort in an attempt to overcome rapidly progressive malnutrition. She was found to have multiple fistulae of the terminal ileum, cecum, and ascending colon with marked chronic peritonitis presenting granulation tissue. A right-sided one-stage resection was performed, with open anastomosis of the ileum to the transverse colon. She died on the fourth day. Postmortem examination showed no acute peritonitis. The wound was healing cleanly. Death was ascribed to malnutrition and terminal pneumonia. The death that may be blamed on succinyl sulfathiazole occurred also in an unfavorable preoperative risk, a man, age 71, with carcinoma of the cecum involving the adherent jejunum, and presenting marked lymph node metastases. An aseptic ileocolostomy was performed after right-sided colectomy as well as an open end-to-end entero-enterostomy of the jejunum following resection of the diseased segment. This patient died on the eighth day. Postmortem revealed death to have resulted from lobular pneumonia with multiple small lung abscesses. Although the abdominal wound was healing cleanly, there was a localized area of fibrinopurulent peritonitis.

It should be noted that all three of the deaths occurred in the group that had had an adequate protein diet. More striking, perhaps, is the observation that 15 of the 16 patients who had had this diet presented no evidence

of peritonitis except for the case already cited that had peritonitis before operation.

Of the 36 cases, 35 lived long enough to determine the nature of wound healing. In these 35 cases only two abdominal wounds were infected. In the entire group of 36 there was no clinical evidence of acute local or general peritonitis and acute local peritonitis was found at postmortem in only the single case cited.

The average highest postoperative temperature in the 36 cases was 100.8° F. In the group with known contamination of the peritoneum the average highest temperature was 101.4° F., and in the group without known contamination 100.5° F. The average postoperative hospital stay for the series was 21.3 days. This is somewhat greater than it should be, since several patients stayed in the hospital for unrelated procedures, such as operation upon the prostate gland. Forty-two per cent of the patients were discharged within 14 days following operation.

Discussion.—These studies have confirmed Firor's and Poth's reports on the characteristics and behavior of succinyl sulfathiazole. The low absorption rate is indicated by the low blood levels and the small proportion of the ingested drug excreted by the kidney. The infrequency of unfavorable reactions has also been demonstrated. Furthermore, the incidence of infected wounds and of evidence of peritonitis even following known fecal contamination is satisfactorily small. Finally, the dramatic diminution of *B. coli* and *B. aerogenes* in the stool following ingestion of the drug has been amply shown.

It is our opinion that the use of succinyl sulfathiazole in large bowel surgery has permitted two desirable improvements in methods. In the first place, we believe that the effective reduction of susceptible organisms in the stool in the presence of a high protein diet makes permissible the employment of a balanced and palatable preoperative nutritional management. The clinical evidence does not support this opinion directly, since the number of clinical cases prepared with adequate diets is too small to be significant. If this conclusion is correct, then patients undergoing resections of the large bowel should, in the long run, be in better state to withstand operation and subsequent starvation and should have a more favorable metabolic background for wound healing.

The second advance that the drug has probably made possible is the disappearance of stage-operations in this clinic. Except for enterostomy or colostomy in the presence of acute obstruction, an operation that has itself diminished in incidence through the use of suction decompression, there have been at the University of Virginia Hospital no stage-operations for carcinoma of the large bowel in nearly two years. We do not hesitate to perform primary anastomosis under permissible anatomic conditions at any level of the large bowel and have seen no disasters as a result. The advantage of this change in technic is obvious. The avoidance of temporary fecal fistula, of the crushing of spurs, of hernia through the site of closed fistulae, of repeated anesthetic hazards and of delay between stages for spread of malig-

nancy, make a one-stage method a boon to both patient and surgeon. The saving of cost and of hospital bed space is an additional accomplishment.

That these two attainments are due to succinyl sulfathiazole must be recorded as an opinion only. It is necessary to point out that the use of other sulfa compounds, both generally and within the peritoneum, may play a part in the results. We have not attempted to isolate the influence of other sulfa therapy from the influence of succinyl sulfathiazole, partly because the cases are so few, and partly because the records unfortunately are not sufficiently complete. In most of our 36 cases sulfanilamide was implanted over peritoneal suture lines and in the abdominal wall. Without succinyl sulfathiazole, however, we would never have dared to do the things that we now successfully carry out.

In addition, it must be pointed out that except for the improvements in technic mentioned, we do not believe that succinyl sulfathiazole should be used to replace older and tried methods of preparation of the patient for large bowel surgery. It does not obviate careful selection of patient, anesthetic and procedure. It does not obviate a period of five days to a week of preoperative hospital care, with adequate measures for the relief of dehydration, anemia, hypoproteinemia, obstruction, and the like. It does not obviate the need for cutting down the bulk of the stool by a low residue diet, and the immediate preoperative washing of the bowel by enema. It is an adjuvant to all these things. In our experience it has been a valuable adjuvant.

CONCLUSIONS

1. Succinyl sulfathiazole is absorbed from the bowel and excreted in the urine in relatively small amounts. The incidence of reactions is small.

2. Ingestion of the drug results in a dramatic reduction of *B. coli* and *B. aerogenes* in the stool in less than five days, in the absence or presence of ulcerative mucosal lesions.

3. This reduction occurs without relation to the nature of the accompanying diet.

4. In this Clinic the use of succinyl sulfathiazole has been associated with two changes in method: (a) The use of a preoperative low residue diet containing adequate protein; and (b) the avoidance under many circumstances of stage-operations.

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THE TREATMENT OF BURNS COMPLICATED BY FRACTURES OF THE EXTREMITIES*

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THE EXTENSIVE USE of gasoline in modern warfare has greatly increased the incidence of burns. Flying and tank personnel are especially liable to this injury and the use of oil in the Navy subjects the sailor to the same hazard. When a burned patient also receives a fracture, the treatment of both conditions becomes more difficult. A review of the medical literature since the onset of World War II fails to show any reference to the treatment of these associated injuries.

In an effort to gather data on this subject a questionnaire was sent to a number of Army Air Fields. The replies indicated that while this combination of injuries was not uncommon the majority of these accidents resulted in death before medical aid could be given. A total of 12 patients who were successfully treated was reported. Despite the limited number of cases, it was felt that these, plus the helpful suggestions received from many sources could serve as the basis for a brief study of this condition.

This discussion will be divided into two parts: The first will deal with the patient who has received a burn and a fracture which do not involve the same anatomic region. This will permit a résumé of our present treatment of burns. The question as to which condition should be treated first will depend upon the nature and extent of the individual injuries. Fortunately this rarely will be a problem, for the initial general treatment is the same for both conditions.

Shock must be prevented or treated immediately. This is best accomplished by plasma in appropriate amounts. Pain is controlled by 16 or 32 milligrams of morphine. Chemotherapy, which is begun immediately, is indicated in both burns and compound fractures.

The local treatment of the fracture and the burn can be carried out simultaneously. A sterile dressing should be applied to exposed burned areas prior to moving the patient, and a similar dressing should be placed over the wound after inserting sulfanilamide crystals when a compound fracture is present. Fractures should be properly splinted before the patient is moved. Burned clothing should not be removed until the patient has reached a station which will permit the entire burn to be dressed under sterile conditions.

For the sake of clarity the recommended treatment for burns will be outlined first. The amount of plasma needed will depend upon the loss of fluid from the burned area plus the amount necessary to offset the associated secondary shock. The loss incident to the burn may be approxi-

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mated by following Berkow's[1] method of estimating the extent of the burned area, and giving 50 cc. of plasma for each one per cent of body area involved. This would mean that a burn of ten per cent of the body surface would require 500 cc. of plasma. This method makes no allowance for fluid loss into unburned body areas as a result of shock, and additional plasma would be needed to offset this. A hematocrit determination, on the other hand, would give an overall determination of the plasma needs, and by following Harkin's[1] rule 100 cc. of plasma would be given for each point that the hematocrit exceeded 45.

Upon arrival at the hospital the patient should be taken to the operating room. Every sterile precaution should be followed that is observed in the course of a surgical operation. The surgeon should scrub for ten minutes before donning sterile gloves, and all participants, including the patient, should be properly masked and gowned.

The local treatment will vary chiefly with regard to the extent of the débridement. The tendency recently has been to do a minimal débridement consistent with removal of devitalized epidermis and all adherent and adjacent potentially contaminated tissue. The circumstances under which the burn was received and the subsequent exposure to infection will enter into this decision. Cleansing with cotton swabs moistened with neutral soap and flushing with large amounts of sterile water or normal saline will suffice in most cases. Burned fragments of skin and adherent foreign material can be removed without anesthesia. The narcosis induced by the morphine should suffice. The excision of charred tissue will depend upon the area involved, the general condition of the patient, and the need for a general anesthetic to correct associated fractures. Immediate skin grafting after excision has been advocated, but this should be confined to patients in excellent condition, with limited burns. A booster dose of tetanus toxoid should be given to all third degree burns and to burns of any degree that involve the region about the buttocks.

When the entire area has been cleansed, it is covered by sterile petrolatum and a layer of fine-mesh gauze is applied. This is followed by several thicknesses of sterile wide-mesh gauze dressing, which, in turn, is reinforced by a thick, evenly applied layer of machinist waste which should extend well beyond the margins of the burn. Compression is obtained by a snug elastic bandage which should be carried from the distal end of the extremity well beyond the upper limit of the burn. Boric acid ointment may be substituted for petrolatum should the latter not be available.

This method may have to be modified frequently in burns of the face and hands, a common site of injury in military personnel. Occlusive dressings about the eyes, nose, and mouth are rarely practicable, for they become soiled quickly and act as a septic poultice. Infection in facial burns is especially undesirable, for not only is grafting delayed, but the scars that follow infected burns are dense and lead to disfiguring contractures. After the initial cleansing, facial burns should be covered with boric acid ointment or sterile saline compresses. Evans and Hoover[2] have obtained excellent

results in this type of burn with 6 per cent sulfanilamide ointment in a fatty base. Careful and individual nursing is essential in these burns. The rôle of the nurse as a morale builder is nowhere better exemplified than in burns of the face.

Compression dressings are difficult to apply to burns about the hands. A débridement followed by saline compresses or soaks in an arm tub is frequently the best treatment. Active motion should be begun early. Flexion deformities should be corrected by application of a banjo splint with elastic traction attached to the finger nails. The majority of severe burns will require skin grafting, and this must be undertaken as early as possible to prevent contractures. Each case must be individualized and every step must be carried out under rigid aseptic technic. It is only by attention to innumerable details that a badly burned hand can be salvaged and an aviator returned to active duty.

The general treatment of a burned patient is equally important during the first few days. Blood pressure and hematocrit readings must be taken at frequent and regular intervals during the first 24 or 48 hours. A falling blood pressure or rising hematocrit should be combatted by an appropriate amount of plasma.

Sulfadiazine should be used prophylactically in all extensive burns. An initial dose of four grams should be given. One gram should be given every four hours if the urinary output is in excess of 1500 cc. daily. The blood sulfa level must be determined daily during the acute phase of the burn. Fluids should be forced and the intake and output carefully recorded. A low intake or vomiting will require intravenous fluids. Determinations of the blood chemistry, especially the nitrogen and chloride values should be made daily for the first week. An increase in the nonprotein nitrogen will necessitate intravenous dextrose injections, and chloride depletion should be corrected by normal or hypertonic saline. The red cell count and hemoglobin should be checked every two days during the acute stage of the burn and at least once a week thereafter. Frequent whole blood transfusions, and a diet high in vitamins, especially C, B_1, B_2 and D, will overcome the anemia and promote epithelization.

The dressing should not be disturbed for ten days or two weeks unless infection is suspected. After removal of the contaminated outer wrappings the dressing should be soaked or moistened with saline for several hours to permit its removal without pain or damage to underlying granulations and epithelium. Sterile precautions must be observed. The condition of the wound will determine the subsequent treatment. In clean wounds with early granulations, a second application of petrolatum or boric acid ointment followed by a pressure dressing may be all that is necessary. This may remain for ten days or two weeks if the local and general condition of the patient remains satisfactory. If uncertainty exists, the burn should be dressed every two or three days. In the presence of infection, or if the area appears unhealthy, saline compresses or soaks should be substituted. Maceration of the skin responds to exposure to air for one or two hours daily. Scarlet

red ointment, by its stimulating and hydroscopic qualities, will often cause rapid epithelization when applied to a sluggish wound with scattered islands of epithelium arising from hair follicles. This ointment, if used sparingly, is also useful in toughening new and delicate skin.

The importance of early skin grafting in third degree burns is now generally appreciated. This can usually be undertaken by the fourth or fifth week. A clean granulating surface and the general condition of the patient are the determining factors. If the hemoglobin is below 75 per cent, whole blood transfusions should be given. Burns about the hands, face, and the flexor surfaces of joints should be given first consideration. Grafting of extensor surfaces and the trunk can wait until the above areas are covered. Exposed areas and flexor surfaces are best protected by thick split-grafts removed by the Padgett dermatome. These should measure about 0.012 inch in thickness. The grafts are sutured in place and a pressure dressing should be applied. A light plaster splint should be incorporated in dressings about joints. The small deep graft of Davis is an excellent general utility graft in burns of the trunk or extensor surfaces. These grafts are economical and survive well in infected areas. Small deep grafts should not be used about the face or hands for cosmetic reasons, and there is a greater likelihood of late contractures following their use.

The treatment of a simple fracture which does not underlie a burned area will differ but little from the treatment of a fracture unassociated with a burn. In general, an immediate reduction followed by a plaster encasement is most satisfactory. This will permit the patient to be turned freely in caring for the burn and avoids the danger of pulmonary complications or pressure sores from prolonged immobilization with traction. Some form of skeletal fixation in fracture of the femur is indicated in order to avoid a spica encasement and to permit ready handling of the patient. Shaar[3] has used external skeletal fixation by means of the Stader splint with excellent results in several cases of fractures associated with burns. External fixation by the Stader, Roger Anderson or Haynes method would appear to be the ideal treatment in cases unsuited for simple reduction and plaster encasement.

A theoretic and doubtless practical advantage in an occasional extensive burn is the availability of the fractured thigh as a possible donor site, if unencumbered by plaster or traction apparatus. The "hanging cast" method of treatment has proved useful in fractures of the humerus. The simplest method of fixation should be used in any fracture, for the mental hazard inherent in all burns would be accentuated by painful and awkward equipment. The treatment of a compound fracture does not differ from that followed in a patient without a burn.

A general anesthetic will usually be necessary in the reduction of fractures associated with burns. Sodium pentothal is especially useful in burns about the face.

This brings us to the treatment of fractures complicated by burns of the same part, in other words, burns of an arm or leg associated with a fracture of that limb. These injuries are more difficult to treat than those that have

just been discussed. Anterior and posterior plaster splints or a circular plaster encasement of the involved part proved satisfactory in several cases reported. A number of those who answered the questionnaire took occasion to point out the potential value in these injuries of a close fitting plaster of paris encasement, as advocated recently by Levenson and Lund,[4] for the treatment of burns uncomplicated by fractures. These authors treated 22 burned patients by the plaster method with satisfactory results. The burns involved the arms and hands in 28 instances and the legs in four cases. The method in brief is as follows: A layer of petrolatum gauze is carefully applied to the entire area. This is covered by four layers of sterile open-mesh gauze. Thin anterior and posterior plaster slabs are molded to the part and a few layers of rolled plaster completely encase the extremity from its distal end to several inches above the upper limit of the burn. The encasement is changed every 14 days until the burn is healed or the area is ready for grafting. The following advantages are claimed by Levenson and Lund: The early application of the encasement prevents swelling of the part and loss of plasma from the burned surface; capillary flow is increased with stimulation of the healing processes; the possibility of secondary infection is obviated; the method requires a minimum of material, it is comfortable to the patient and after care is greatly simplified.

This method holds great promise for the treatment of burns of the hands, forearm and legs complicated by fractures of the underlying bones. The burned area should be cleansed in the recommended manner before the fracture is reduced. The position should be checked roentgenologically, with especial care not to jeopardize the sterile technic. A good reduction is essential for the success of this method. This treatment could be followed also in compound fractures by combining with it the Orr method, which is based on the same principle of wound treatment. It would be wise, however, to modify the method in one respect until sufficient experience is obtained to prove or disprove the need for this safeguard. Despite the admonition of Levenson and Lund that the plaster must be closed at the lower end of the extremity, it would be far safer in these combined injuries, with a deep as well as a superficial source of swelling, to leave a small opening at the distal end of the encasement to permit inspection of the circulation. An opening no larger than the cross-section of the fingers would hardly upset the fluid balance established by the remainder of the plaster encasement and it would determine whether the circulation was adequate.

The amount of dressing applied to the part depends upon the time that elapsed between the injury and the application of the encasement. The greater the interval the more abundant should be the dressing. The accuracy of the reduction of the fracture also determines the degree of subsequent swelling, and this has to be considered in dressing and encasing the part.

This method lends itself well to the treatment of fractures of the leg and forearm. Fractures of the humerus and femur would require a different type of handling. In fractures of the humerus a compression dressing is applied to the entire hand, forearm and arm while reduction is accomplished

by the constant traction obtained from a superimposed "hanging cast." Skeletal traction is, of necessity, the method of choice in the treatment of fractures of the shaft of the femur complicated by overlying burns. In most cases an unburned area about the leg or ankle will permit the insertion of skeletal traction through normal tissue. An occasional extensive burn will be encountered which will entail the passage of a pin or wire through a burned area. The likelihood of deep infection will be minimized by an intensive preliminary débridement at the site of insertion of the skeletal traction. The recommended compression dressing can then be applied to the burn. Three patients in this series with burns of the thigh and fractures of the underlying femur were treated successfully by skeletal traction. In one case it was necessary to insert a wire through burned tissue. Infection did not develop. In a fourth patient with a fracture of the femur and an overlying burn, traction was omitted and a marked shortening resulted.

The general principles governing the prevention of infection in wounds and burns, outlined recently by a committee of the National Research Council,[5] is of especial value in handling complicated wounds of this type. These measures include the segregation of burned patients, a uniform time and method of dressing the burns, a routine for sterilization of ward equipment and suggestions as to the application and removal of plaster encasements.

In closing, I should state that I realize the conclusions outlined in this paper are based upon relatively few cases, and that their value is limited to a corresponding extent. There is a need, however, for more information on this difficult subject and if this presentation stimulates discussion its preparation will be justified.

The author wishes to express his appreciation to the following medical officers for aid in the preparation of this article: Lt. Col. Alfred R. Shands, Jr., Orlando, Fla.; Lt. Col. I. R. Trimble, A.P.O. 927; Lt. Col. Harold H. Hamilton, Westover Field, Mass.; Major Paul N. Mutschmann, Biggs Field, Tex.; Major John E. McDonald, S.A.A.C.C., San Antonio, Tex.; Major Bernard B. Larsen, Truax Field, Wis.; Major Charles R. Burbacher, Morrison Field, Fla.; Major Paul G. Morrissey, Maxwell Field, Ala.; Major John A. Martin, Randolph Field, Tex.; Major Foster L. McMillan, Lowry Field; Major H. J. Veatch, Homestead A.A.F., Fla.; Capt. Thomas B. Keller, Salt Lake City A.A.B., Utah; Capt. C. D. Brown, Peterson, A.A.F.; Capt. Louis C. Olker, Douglas A.A.F., Ariz.; Capt. Ralph F. Spencer, Mitchel Field, N. Y.; Lt. Gerald I. Cetrulo, Rosecrans Field, Mo.

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DISCUSSION.—DR. PAUL B. MAGNUSON, Chicago, Ill.: I feel that Doctor Warthen's paper is so important that it should not be allowed to pass without discussion of the terrifically complicated conditions he mentioned. If there is any place in surgery where one needs all the ingenuity he can muster, it is in these fractures complicated by burns.

Doctor Warthen spoke of putting wire through a burn, and it occurs to me that the point of insertion of the wire is very important. Ordinarily, in the femur, we put it in from the outside to the inside, which is the handiest method. However, in a case of this kind a little maneuvering might be in order, to start it on a clean surface; reversing the usual process and putting it through at a point where the skin can be prepared, and then bringing it out through the wound surface would reduce the hazard of infection materially. On these little details often depends the success of treatment in such complicated injuries, and the ultimate result is largely dependent on the ingenuity of the surgeon at the time the wound is originally or secondarily treated.

DR. J. M. T. FINNEY, Baltimore, Md.: I have very little personal knowledge of the subject of Doctor Warthen's paper, but recently I have had occasion to talk to Captain Owsley of the Medical Corps of the Navy, who was successively surgeon on two large aircraft carriers in the South Pacific, one of which is no more. During that time they had a considerable number of compound fractures complicated by extensive burns. I have never served on a carrier, so I do not know much about it. He says their equipment is limited, and their knowledge of how to treat these cases was also limited at that time. Because of this, they tried to start with treating the fracture until they could get to a hospital, which was sometimes a period of several weeks. The standard procedure was to clean the surface of the burn, which usually involved the leg or arm with the compound fracture, apply liquid petroleum or vaselined gauze, then put on a tight plaster encasement and leave it. Much to his surprise, when the encasement was removed they found that the burns had healed, or were healing satisfactorily. As a result of this experience, under his direction at the present time this is the method of choice in cases of burns plus fractures. He said it is surprising even in third degree burns, from the standpoint of comfort of the patient, rapidity of healing, and satisfaction of the method of treatment.

DR. ALTON OCHSNER, New Orleans, La.: There is a recent contribution which you may not be familiar with because it appeared in the Public Health Reports. Rosenthal developed a technic for burning mice, which produced death in approximately 95 per cent of the cases. By the administration of mouth serum and albumen he was able to prolong the life of the mice somewhat, but by the administration of sodium chloride intraperitoneally 90 per cent of the mice could be saved.

Fox introduced this form of therapy in a group of patients at the Harlem Hospital. In approximately 50 severely burned patients receiving large quantities of sodium lactate solution by mouth, because it was impossible for the patients to drink much sodium chloride, very good results were obtained. Of the group, only one patient had plasma and this was a severely burned patient who received but one unit of plasma.

Rosenthal was able to show by means of radio-active sodium that the sodium in burned animals became fixed in the tissues, particularly in the normal and burned skin, in the muscle, and in the bone. Both in the humans and in the animals there was no excretion of sodium until about the thirteenth or fourteenth day. Rosenthal is of the opinion that the beneficial effect obtained by the administration of plasma in burns is due to the sodium content of the plasma.

MAJOR H. J. WARTHEN, JR., Richmond, Va. (closing): This paper should really have been prepared by a naval surgeon, rather than by a doctor in the Air Force. The cases that occur in the Navy are more likely to survive than those that occur in airplane accidents. Judging by the replies to the questionnaire I sent out, for every case reported that lived, five or six cases died immediately or within a few hours after the accident.

I was pleased to hear Doctor Finney's account of Captain Owsley's experience, because, fortunately, it coincides with our conclusions based on the limited number of cases we have had. I would leave a small opening at the end of the plaster when a plaster encasement is used for treatment of combined burns and fractures.

Doctor Magnuson mentioned that most of these pins can be placed through an unburned area. I think this is true. There should be some area from the knee downward that is uninvolved, particularly the ankle. In one patient in our series it was impossible to find a single unburned area in the ankle or leg that would permit passage of a pin, and in that case the surgeon cleaned up the area, passed the pin through the burn and no ill results occurred.

POSTOPERATIVE SALT INTOLERANCE*

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THE EXPERIENCE OF YEARS regarding the toxicity of isotonic sodium chloride solution has been forgotten. Trout and Evans urged caution in the use of isotonic saline solution over thirty years ago. The clinical experiments that Trout reported, although few in number, enabled him to draw conclusions that hold the essence of the whole problem. It seems appropriate then that Trout should be quoted: (1) "Even we surgeons know of the wonderful improvement in some patients with nephritis when placed on a salt-free diet, and all of us realize there is a transient renal irritation or possibly a nephritis following the majority of anesthetics and infections. In seven cases in our series the following coincidence has been observed; a transient albuminuria remained in every specimen for two days after an anesthetic when using salt solution per rectum. Water was then substituted, and at the end of 24 hours the albumin had disappeared. At this time a return was made to salt solution, with the appearance of albumin and a few hyalin casts in from six to 24 hours. Patients were then placed on a limited salt diet, and the urine in every case promptly returned to normal and remained so until discharged from the hospital. In none of these cases was there any edema. (2) In this entire series, in both the salt and water cases, there have only been 121 who complained of being thirsty, and of this number 112 of them were salt cases. There were 27, or over one-fourth of these cases, who complained of tasting salt when they had absolutely no way of knowing that they were being given saline by rectum, and the solution being prepared so as to be 0.6 to 0.9 per cent sodium chloride. Furthermore, the water cases have taken one-third more fluid by rectum than the salt cases, and the latter have required nearly twice as much water by mouth to relieve thirst. (3) It is true sodium chloride is the least toxic of the group of similar metal chlorides, but even at that it is a poison to all people when given in large doses, and occasionally very toxic in small doses to a certain class of cases; and we believe this peculiarity is apt to be present in patients whose resisting powers are lowered by operations and infections."

The purpose of this discussion is to retract the so-called clinical rule that was proposed in 1938, and to bring to your attention Trout's and Evans' conclusions. It is generally true that the body of a normal person is capable

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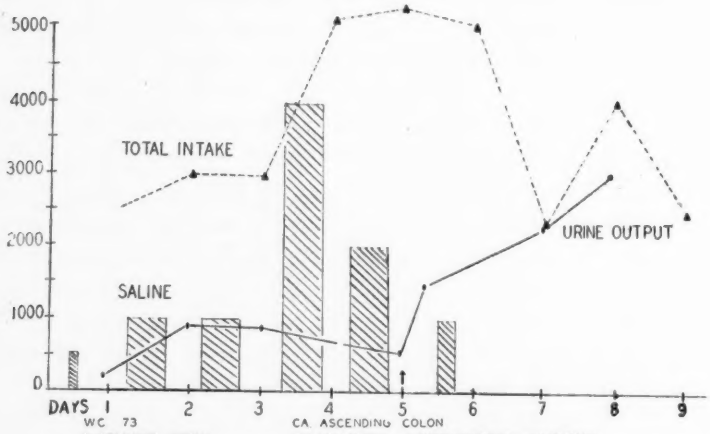
of handling relatively large amounts of isotonic saline solutions without showing signs that would indicate that a significant derangement in the regulation of body functions had occurred. However, there are many individuals who are incapable of tolerating relatively small excesses of salt solution, *during the immediate postoperative period.* The type of illness that may follow the administration of saline or Ringer's solution varies. There are three predominant and fairly distinctive symptom and sign complexes. The cases that are presented illustrate these arbitrary complexes.

CHART I



PO DAY	NPN	CO2 VOL.%	PLASMA CL' AS NACL	SALINE	TOTAL INPUT	URINE OUTPUT	EMESIS	WANG	REMARKS
1				500	2500	200			
2				1000	3000	875	50	350	SUCTION STARTED
3				1000	3000	850		1600	DEEP RESPIRATIONS
4	101.6	46	438	4000	5900	625	200	1350	DROWSY, CONFUSED
5	113.7	59	445	2000	6000	350/1340		1150	MERCUPURIN-ADRENALIN
6	104.5	70	467	900	4900	3900		880	STILL IRRATIONAL
7	67.3		508		2300	2300	100		SL. IMPROVED
8					4080	2800	850		IMPROVED
9	49.1	62			2500	1975	200		IMPROVED
10	50.8			1000	3000	1950			IMPROVED
11					3555	3200	420		IMPROVED
12	37.5				2700	2350	500		EATING, DRINKING

Case 1 represents the most insidious and, in our experience, the most common form of "salt intolerance." The symptoms and signs are primarily referable to the central nervous and digestive systems. They are weakness, disorientation, anorexia, nausea, vomiting, distention and an increasing depth of respiration. The rate of urine excretion decreases slowly, the N. P. N. of the blood increases, the carbon dioxide combining power falls, and the plasma chloride level tends to remain constant although a large amount of salt may be administered in an attempt to raise it should it be below normal. Recovery is slow. Paradoxically, as the person improves the plasma chloride level, if it is low, rises without the administration of the chloride ion.

Case 1.—W. C., male, age 73, was operated upon under a spinal anesthetic that

CHART II

M.L. ♀ 61 yr. Adenocarcinoma rectum. Comb.Abd.-perineal resect. Spinal anesth.

P	Pre-Op.	Oper.	1	2	3	4	5	6	7	8
Oral	0	0	0	0	0	200	0	0	200	0
Saline		3000	3000					700	300	300
Glucose				3000	2000	2000	3000	2000	2000	2000
Lactate					250	250			500	
Blood		500								
Urine O-P		990	1380	1750	1125	1700	1750	1850	1150	1150
Emesis			150			750	700	100		
Wangensteen					1050		800	50		
NPN mg/100	25	22		19		31				
CO_2 vol %	59	56		55		77	77			68
Chloride mg%	634	634		622		535				568
Progress	Consid. a good risk	Duration 2½ hours No shock		Nausea, emesis Drowsy. Abd. Dist. Colos. not funct.		Emesis. Abd. Dist.		General Improvement obvious. Alert. Abdomen soft.		

had to be supplemented with ether. A resection of a neoplasm of the ascending colon and an ileotransverse colostomy were performed. On the first postoperative day, oliguria was present. During the first five postoperative days a positive fluid balance of five liters was amassed. With it the clinical signs of acidosis developed and a chemical analysis of blood on the fourth postoperative day substantiated the clinical opinion. The plasma chloride level was found to be low; the apparent deficiency of chloride was thought to be due to an excessive loss through gastric drainage and transudation into the small gut. As a consequence, upon the basis of the "clinical rule,"* 4000 cc. of saline were given intravenously in addition to 1900 cc. of 5 per cent glucose. His condition deteriorated rapidly, the distention increased in spite of massive gastric drainage, edema appeared, he became completely disoriented, and his urinary excretion decreased. However, the plasma chloride level remained stationary instead of rising to about 560 mg. per cent as had been anticipated. The next morning 2000 cc. of saline and 1000 cc. of glucose solutions were given and by evening he had excreted only 225 cc. of urine (12-hour period). His condition was precarious; respiration was noisy and difficult, the edema had increased, and cyanosis had appeared. It was realized then that the initial low chloride content of his plasma represented an attempt to compensate for an acidosis which likely had both an inorganic (urinary suppression) and a respiratory component (distention and emphysema).

Three liters of 10 per cent glucose, mercupurin, and epinephrin in oil were given to him. In the next 12 hours 1350 cc. of urine were excreted. The CO_2 combining power rose, the N. P. N. began to fall, and respirations became dry and easier. On the sixth postoperative day the intern, from habit, ordered saline, and 900 cc. had

CHART III

O.P. ♂ 78 yr. Adenocarcinoma rectum. Colostomy. Spinal Anesthesia.

	Pre-Op.	Oper.	1	2	3	4	5
Oral	0	0	0	0	0	1730	1910
Saline		2000	3000				
Glucose				3000	2000		
Lactate				250			
Urine O-P		1550	850	1505	2550	2000	1125
NPN mg%	43	41		41			
CO_2 vol%	33	35		42			
Chloride mg%	334	648		607			
Progress		Disoriented.		Drowsy. Abd. dist. Edema eyes, ankles.	Improved mentally Dist. less. Edema less	Clinically improved. Cheerful, well oriented. No edema.	

* For each 100 mg. per cent the plasma chloride is below 560 mg. per cent, give 0.5 Gm. of salt per kilo of body weight.

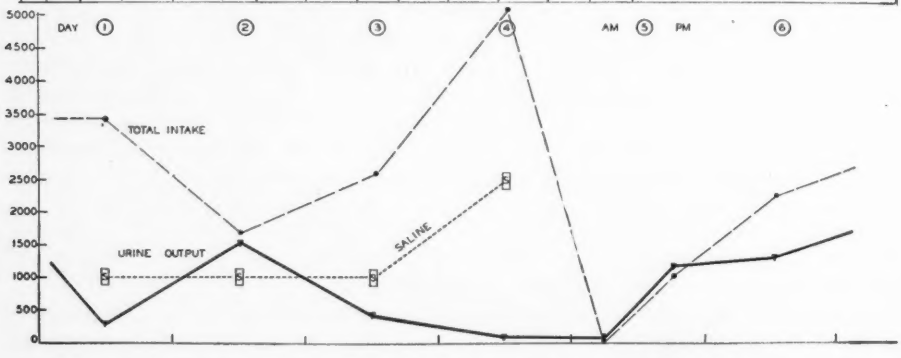
been given before the error was discovered. The patient's recovery was gradual and was associated with a negative fluid balance for seven days (Chart I).

Cases 2 and 3.—Cases 2 and 3 (consult Illustrations II and III) show that the early symptoms and signs that accompany a relatively small, acute chloride excess are not accompanied by, or due to, any gross changes in acid base equilibrium, plasma chloride, or N. P. N. This observation substantiates the conclusions of Sippel and of Evans, in that it makes it appear that the toxic symptoms may be attributable to the excess of the chloride ion in saline solution.* These three cases and many others have convinced us that the use of the "clinical rule" for chloride replacement is dangerous, especially when employed without a sound knowledge of biochemistry and physiology, and that it should not be employed.

CHART IV

A.B. 58 R.U.L. LOBECTOMY

P.O. DAY	NPN	CO2 VOL %	PLASMA NACL	PLASMA PROTEIN	ORAL	SALINE	GLUCOSE	BLOOD	LACTATE	TOTAL INPUT	URINE OUTPUT	EMESIS	DRAIN WANG	REMARKS
1					+	1000	1900	500		3400*	300			5-HOUR ANESTHESIA — REACTED WELL
2					690	1000				1690	1535			FAIR DAY
3					600	1000	1000			2600	400		500	LARGE LIQUID STOOL VOMITING—ABDOMINAL DISTENTION
4					100	2500	2500			5100	135	1250	500	CONDITION WORSE IRRATIONAL—ABD. DISTENTION—NO FLATUS
AM 5		77			0	0	0			0	110		1780	CONDITION VERY POOR — IRRATIONAL HICCOUGHS—LUNGS WET—MUCOID SPUTUM
PM 5					0	0	0		1000	1000	1150	0	1000	STRIKING IMPROVEMENT AFTER LACTATE
6	55	87	413	4.46	500	250	1000	500		2250	1250	0	0	HUNGRY—EATING AND DRINKING RATIONAL—LUNGS DRY—RECOVERY



Case 4.—A. B., male, age 58, underwent a right upper lobe lobectomy. Ether vapor was used as the anesthetic agent. The general features of his illness, a fulminating oliguria that was associated with a rapid physical deterioration, are similar to those of the case reported by Sippel in 1910. The usual immediate temporary postoperative oliguria is apparent (Chart IV). During the forenoon of the third postoperative day he was found to be distended, he began vomiting, and he passed a large liquid stool. The urinary rate of flow began to fall after the diuresis of the second postoperative day and by the fourth day only 135 cc. of urine were excreted in the preceding 24 hours. He became irrational, and in spite of the administration of 5,000 cc. of intravenous fluids (2,500 saline) during that day, he excreted only 110 cc. of urine in 12 hours. His condition had become precarious (Chart IV). One thousand cubic centimeters of M/6 r. sodium lactate were given.† During the next 12 hours 1.150

* The chloride ion concentration in isotonic saline is greater in relation to the sodium ion than it is in plasma.

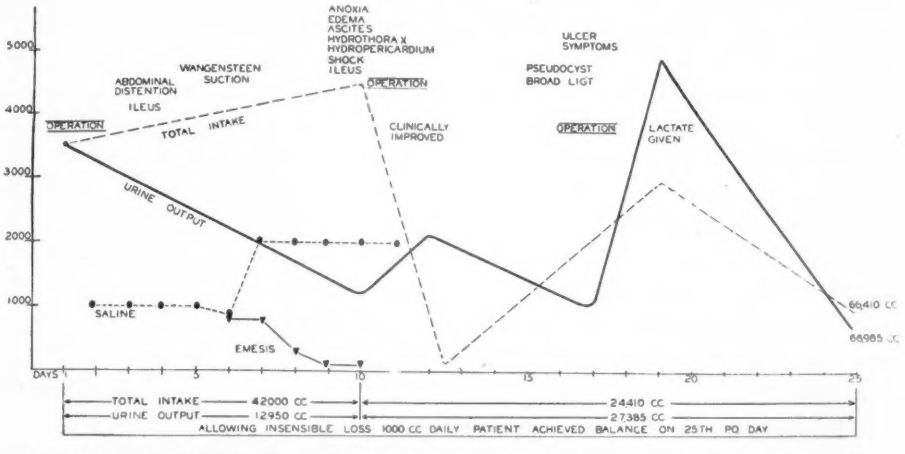
† Unpublished work indicates that the oliguria accompanying "salt intolerance" is best relieved by the administration of sodium that is not in combination with chlorine or the anions of other strong acids.

cc. of urine were excreted and thereafter his improvement was rapid. This man had had frequent examinations of urine made preoperatively and no red blood cells, casts, or albumin had been found.

The fifth case (Chart V) demonstrates an extreme accumulation of fluid in serous cavities as a result of a relatively prolonged, though a slightly excessive, administration of sodium chloride.

Case 5.—G. B., female, age 40, underwent a subtotal hysterectomy under ether anesthesia. She was given daily 1000 cc. of isotonic salt solution in addition to 2000 to 2500 cc. of 5 per cent glucose. On the fourth postoperative day she became

CHART V



DATE	SOURCE FLUID	NPN	TOTAL N	ALBUMIN NIT	GLOBULIN NIT	A/G RATIO	TOTAL PROTEIN	CHLORIDE	SODIUM	POTASSIUM	REMARKS
8-28	ABDOMEN	35.2	481.9	288.3	158.4	1.71	2.79 GM%	98.5 MEQ/L	133.8	4.66	4-5 LITERS RECOVERED
9-1	ABDOMEN		232.7	++++	+		1.45				PARACENTESIS
9-2	TUMOR	151.9	280.0	++++	0		0.80	88.75	133.8	6.62	COLPOTOMY

DATE	GLOMERULAR FILTRATION RATE C_I	EFFECTIVE RENAL BLOOD FLOW C_D	FILTRATION FRACTION $\frac{C_I}{C_D}$	REMARKS
8-28	101 CC./MIN	398 CC./MIN	0.364	10 DAYS PO.
9-4	74.7	305	0.397	
9-18	44.7	300	0.223	RT. HYDRONEPHROSIS

distended, on the fifth day she began to vomit, on the sixth day gastric suction was begun and the parenteral fluids were stepped up to 2000 cc. of saline and 2000 cc. of 5 per cent glucose *per diem.*

Her distention increased rapidly in spite of profuse gastric drainage; by the evening of the tenth postoperative day she was practically *in extremis.* The distention was so great that the respiratory excursions were practically imperceptible. She was deeply cyanotic in spite of the fact that her hemoglobin was less than 60 per cent of normal. Her pulse was small, late, and thready, and her apex beat was very weak. A generalized one plus edema was present. During the ninth and tenth postoperative days repeated attempts had been made to pass a Miller-Abbott tube but they were not successful. Because death from respiratory embarrassment was almost certain within a matter of hours unless the distention could be reduced, it was decided that a gastrotomy should be performed and an attempt made to pass the tube directly through the pylorus. Upon entering the abdominal cavity a massive ascites was encountered, four liters of fluid were collected and another liter was estimated to have been lost.

The sodium and chloride ion concentration in this fluid was the same as it was in her

plasma. The protein content was 2.79 Gm. per cent with an A/G ratio of 1.71. Her stomach wall was approximately 2 cm. thick, her liver was enlarged and so soft that it felt like a hollow viscus. The small intestine was distended with fluid and only a small amount of gas was seen in it. There was no gross edema of the small intestine. Her omentum was a thick, amorphous, opalescent mass. After the greater part of the ascitic fluid was removed, the wound was closed. By the time she was placed in bed respirations were normal, her pulse rate had fallen, blood pressure had risen from 60/20 to 100/70, and consciousness had returned. No more "physiologic" saline was given to her and she recovered.

Cases 1, 2, 3, and 4 differ from Case 5 in that the bloods of the former contained normal amounts of hemoglobin and plasma proteins and no physical renal complications were introduced when they were operated upon. Case 5 suffered from a microcytic, hypochromic anemia and hypoproteinemia (Hb. 46 per cent and p.p. 4.26 Gm. per cent) at the time she had been operated upon* and on the sixteenth postoperative day her right ureter was found to have been obstructed at the level of the pelvic floor. This case demonstrates clearly the "washing out" effect of salt solution upon the serum proteins and the increased tendency for salt retention in hypoproteinemic states, facts which have been brought previously to our attention by Blalock.

Cases 1, 4, and 5 and nine others came to our attention during a three-month period during 1942.† Since that time no saline or Ringer's solutions have been given during the operative and immediate postoperative (48-hour) periods unless losses of extracellular fluid occurred (diarrhea, sweating, fistulous drainage, *etc.*). Extracellular fluid losses are now being replaced according to the volume for volume rule by 0.5 per cent NaCl solution to which 50 Gm. of dextrose per liter has been added. The water needs of the patients are met entirely with plain glucose solution. The practice of giving 5 Gm. of salt daily "for maintenance" has been discontinued because the salt conserving capacity of the kidneys is practically perfect.

The clinical rule (see footnote page 535) for correcting extracellular fluid deficiencies has been found to be highly inaccurate and dangerous. Its formulation and use in the University of Michigan Hospital was based upon the assumptions that the chloride level of the plasma varied directly with the extracellular fluid volume from a normal of 560 mg. per cent and that the plasma chlorides maintained a fixed relationship with the sodium ion. Both suppositions had been proven to be false, especially during illness, at the time the formula was proposed. It has been known for many years that the chloride level of the plasma could vary without a significant change in the hydration of the body. An increase of blood anions, other than chloride (bicarbonate, phosphate, citrates, acetone bodies, and lactate) is associated with a compensatory fall in chloride and need not be associated with any significant change of E. C. F.

In addition, a non-compensatory decrease of the plasma chlorides signifies that a dilution of plasma (E. C. F.) electrolytes has taken place. The

* Repeated unsuccessful attempts had been made to give her blood preoperatively.

† Cases 2 and 3 were induced during an investigation of the problem.

rate and extent of the dilution has no fixed relationship with the state of hydration, especially in different individuals. Therefore, the plasma chloride level alone cannot serve as a sufficiently accurate base for the construction of a universal hydration formula. The failure of the formula and its dangers are well illustrated in Cases 1 and 4. Earlier observations regarding the efficacy of the formula were made by Powers, *et al.*

At present, the restoration of extracellular fluid deficiencies is not being made primarily upon the basis of variations from normal of ions or molecules in blood (Cl, CO_2 combining power, plasma proteins, Hb., *etc.*) but upon the basis of the clinical status and physiologic response of the individual to test doses of parenteral fluids.

Examples may serve to clarify this method:

Example 1.—A patient, age 60, enters the hospital with pyloric obstruction. He has been vomiting for three weeks. He has lost 20 pounds. He is not thirsty, the specific gravity of his urine is 1.014, his temperature is normal, his pulse is 80 and full, he answers questions readily and at length, he complains of slight lassitude. His plasma chlorides were 460 mg. per cent and the CO_2 combining power was 50 vols. per cent.

The lack of thirst and the low specific gravity of his urine indicate that he has been retaining enough water to prevent dehydration. His normal temperature, normal mental responses, and normal pulse indicate that although his extracellular fluid volume may be below his ideal normal, the reduction has been fully compensated. The low plasma chloride is not regarded as an indication for the immediate administration of over three liters of saline as would be given should the "clinical rule" be employed. Instead the low chloride level is considered to be compensatory to the "starvation acidosis" (weight loss of 20 pounds in three weeks), and only one liter of saline is given to him as a test dose. If his physiologic status does not change after receiving the saline, he is considered to be compensated and on succeeding days the gastric aspirations are replaced by equal volumes of 0.5 NaCl solution, in addition to glucose solution in sufficient amount to prevent thirst and maintain the specific gravity of the urine below 1.020.

Example 2.—A man, aged 60, suffering from pyloric obstruction enters the hospital after vomiting for three weeks. His weight has decreased 30 pounds within that period. He is thirsty, his temperature is 97° F., his pulse is 80 and soft, he answers questions in monosyllables, he goes to sleep between questions, his respirations are shallow and slow. The specific gravity of his urine is 1.028, the plasma chlorides are 400 mg. per cent, his CO_2 combining power is 90 vols. per cent.

The thirst and high urine specific gravity indicate a need for free water. The subnormal temperature, apathy, and soft pulse show that a dangerous reduction in extracellular fluid volume has occurred. The alkalosis is disregarded.

MANAGEMENT

The intravenous drip is set as follows:

1st bottle—10 per cent glucose, 1000 cc.
2nd " —Ringer's solution, 1000 cc.
3rd " —10 per cent glucose, 1000 cc.

If thirst remains or if the specific gravity of the urine is above 1.020, the fourth bottle is glucose. If not, it is Ringer's solution, and the second bottle of Ringer's is given very slowly (200 cc. per hour). Should the patient's pulse fill out, his mind become clearer and his temperature rise appreciably before the second liter of Ringer's has been given, the injection is stopped.

Upon each succeeding day glucose is given first in amounts sufficient to allay thirst completely and to keep the specific gravity of urine at least in the 1.010–1.020 range. This is followed by one liter of Ringer's solution daily (in excess of the volume-for-volume replacement of drainage by 0.5 per cent, Ringer's) until the CO_2 combining power and plasma chloride values have become constant. If the plasma Cl and CO_2 combining power reach plateaux before their arbitrary so-called normal values are reached, no attempt is made to change them further. Considerable departure from normal in Cl and CO_2 combining power can be expected in starvation, emphysema, *etc.*

The type of saline solution administered also depends upon the clinical status of the patient. In the preceding examples simple repair solutions (saline or Ringer's solution) will satisfy requirements. However, in a case such as follows, a buffered solution is considered to be indicated:

Example.—Patient age 70, weight 60 Kg., with pyloric obstruction and vomiting for three weeks, entered the hospital in semicoma. Urine, catheterized—20 cc., sp. gr. 1.035, contained albumin, casts, and red blood cells. Respiration was deep and labored, pulse weak and irregular, CO_2 combining power 30 vols. per cent, plasma chlorides, 200.

In this case urinary suppression has resulted in a retention of acid radicles of sufficient degree to counteract the tendency of chloride reduction to produce an alkalosis and instead a severe "uremic" acidosis is superimposed upon a reduction of total base from vomiting. This man obviously is in great need for a rapid replacement of extracellular fluid, but in the face of the anuria, no solution should be given which has a chloride content in relation to sodium that is greater than is present in his plasma, or the acidosis may be increased beyond tolerable limits. For that reason, normal saline and Ringer's solution (chloride, 150 m. eq. vs. 100 m. eq. in plasma) are considered to be less adequate from a physiologic standpoint than Hartmann's solution. The plan of administration is as previously outlined.

SUMMARY AND CONCLUSIONS

1. Three clinical types of "salt intolerance" are described.

2. Because of the relatively high incidence of "salt intolerance" following a general anesthesia, it is felt that no *isotonic* saline solution or Ringer's solution should be given during the day of operation and during the subsequent

first two postoperative days. The fluid requirement of the patient is met with glucose solution. If a significant loss of extracellular fluid occurs during the above period, it is replaced with 0.5 per cent sodium chloride solution to which 50 Gm. per liter of dextrose has been added. Isotonic saline solution (0.9 per cent) or Ringer's solution is used to replace extracellular fluid loss after the postoperative urinary suppression has disappeared, usually after the second postoperative day.

3. Great care must be used in administering isotonic saline and Ringer's solution to patients who are hypoproteinemic, anemic, acidotic, or oliguric.

4. It is recommended that the correction of uncompensated extracellular fluid deficiency states be made upon the basis of the physiologic response to test doses of the appropriate salt solution rather than upon the basis of the plasma chloride, the CO_2 combining power, the N. P. N., the plasma protein, or the hemoglobin levels. Three examples are given to illustrate the method.

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DISCUSSION.—DR. ROBERT L. RHODES, Augusta, Ga.: Doctor Coller referred to a paper published in 1913 by Doctor Trout, with whom I was associated at the time. I had not thought of that for a long time. I am reminded in these days of shortage of man power and woman power in hospitals of some thoughts brought out in that paper. In 1910 we began a comparative study of rectal administration of salt solution and water, on alternate cases operated upon; there were 2000 consecutive cases, 1000 of each. Out of the 1000 that had salt solution, approximately 125 or 150, 12 to 15 per cent developed edema, and when the salt solution was shifted to water the edema subsided.

It is a very simple matter to give water by drip, not the Murphy drip, but the Lawson drip, described by him in May, 1900. The original dropper was a simple medicine dropper inserted into a test tube. When first brought out the dropper was too slender, so that if not held perfectly erect the drop would span the gap between the two tubes and syphonage would result instead of drops. The larger bulb effect was designed by me, and first made by Wocher of Cincinnati upon order for us. This bulb avoided syphonage even when lying almost flat. Later someone stuck a hole in the bulb with the thought of allowing gas to escape, but what it really does is allow suction of air to come into the bulb and be carried into the rectum between the drops of the solution and produce irritation of the rectum. When this hole is sealed-off with adhesive tape and the dropper is regulated to 40 drops per minute, you have a foolproof mechanism. At this rate the fluid is absorbed about as rapidly as it is introduced and any collection of gas in the rectum is easily expelled beside the small indwelling catheter.

As he published, the amount of water a patient would take is approximately one pint more than salt solution, without producing edema. John B. Murphy was the first to suggest rectal administration of fluid, but with a large tube which produced irritation. Our studies show that a small catheter slipped into the bowel for three or four inches and strapped to the buttocks would not irritate the sphincter muscle or rectum, could be left in position for days and, at 40 drops per minute, three quarts of water, saline or glucose could be easily given in 24 hours. Many medicines may be added to the solution and given in this way.

DR. ALFRED BLALOCK, Baltimore, Md.: I admire a person who can find imperfections in his own work. Doctor Coller, and his associates, have been correct in most of their teachings on the treatment of dehydration and I am delighted that it is they rather than others who find that the quantity of salt solution which they have recommended under some circumstances has been excessive.

I am particularly interested in Doctor Coller's remarks on the effects of an excessive quantity of salt solution on the kidneys. Some of the peculiarities of the kidneys in impending or fully developed shock have been pointed out recently by Van Slyke, and his associates. It is well known that the blood flow through the extremities diminishes greatly in early shock. It has not been appreciated that the kidney circulation behaves in a similar manner. With only a slight diminution in the arterial blood pressure, the renal blood flow usually declines quite markedly. This reduction in flow is particularly bad since the kidneys (unlike the extremities) do not remove increasingly large amounts of oxygen from the reduced quantity of arterial blood passing through them. In other words, the oxygen consumption of the kidneys in impending peripheral circulatory failure is considerably reduced. These observations may explain in part the interesting findings of Doctor Coller.

Doctor Ochsner spoke this morning of the interesting recent work of Doctor Rosenthal on the experimental use of salt solution in treatment of burns. Perhaps it is well to point out that rather tremendous amounts of fluid were given and that this was administered before shock had developed.

In the treatment of shock we should attempt to make up for the deficit in blood volume by administering fluid of essentially the same composition as that which has been lost. Despite the great virtues of blood plasma, I think that we have too great confidence in its usefulness under certain circumstances. Many instances of shock are due to the loss of whole blood and replacement therapy should include the administration of whole blood. The necessity for this has been emphasized by Doctor Churchill, Doctor Beecher, and others. One should bear in mind that red blood corpuscles are needed for the transport of oxygen. Even though the blood volume is brought back to an essentially normal level by the administration of plasma following hemorrhage, the anemia causes a great increase in the amount of work which has to be performed by the heart.

TREATMENT OF METASTATIC CARCINOMA OF THE NECK*

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CARCINOMA OF THE MOUTH AND LIPS tends to remain confined in the head and neck, thus presenting a considerable chance of cure even after metastases have occurred. As early as 1906, Crile[25] published the findings of a review of 4,500 autopsies in which distant metastases were found in less than 1 per cent and though other slightly higher figures have been published since, all have been under 10 per cent.

The first metastases usually appear in the lymph nodes which drain the immediate area, and in this stage the disease is still relatively curable. Subsequently, there may be widespread permeation throughout the neck on both sides anteriorly and posteriorly, probably because of the extensive lymphatic communications.

As elsewhere in the body, the metastases vary with the grade of malignancy of the primary lesion. A huge, fungating lesion of long duration may be accompanied by no cervical metastases while another patient may have large neck masses from a minute ulcer in the mouth or pharynx which may be difficult of detection.

Cervical metastases occur with such frequency, however, that any good plan for treating these patients must be directed toward the cervical nodes as well as the primary lesion (Fig. 1). In general, the choices of treatment are radiation or surgery, or some combination of the two.

RADIATION TREATMENT

External roentgen radiation is still advocated by some workers for operable metastatic squamous carcinoma in the cervical lymph nodes. In the literature for the last fifteen years, however, no five-year cures from this treatment were found where the disease had been definitely proven by nodal biopsy. Negative evidence has been supplied by Simmons[107] who reported 108 cases, and Forsell[47] (from the Radiumhemmet) who reported 72 cases (treated by external radium or roentgen radiation) without even one cure. Many radiologists have taken a definite stand against this form of treatment.†

*Read before the Southern Surgical Association, December 7–9, 1943, New Orleans, La.

†Berven[4] (from the Radiumhemmet in Stockholm) stated: "Roentgen treatment, as technically carried out at present only seems capable of producing shrinkage of the glands for some longer or shorter period of time with subsequent palliation. The metastases later begin to grow in spite of roentgen treatment then undertaken."

All of the reported five-year radiation cures, in which positive nodal biopsies were obtained, have been from interstitial implantation of radon seeds directly into the nodes and surrounding tissue, often after surgical exposure. Auxiliary roentgen radiation has also been employed in some instances. Clarkson[21] reported one case in which the node involvement was metastatic from the face and radon was implanted after its removal. Both of the other reports have been from Memorial Hospital, and Martin's[68] series apparently included Duffy's.[31] Duffy's patients all had operable neck masses and he found, after examining the records at Memorial Hospital over many years, that there was never more than 2 per cent variation in the 20 per cent cure for surgery and the 4 per cent cure for radiation of operable metastases (Table I).

TABLE I

FIVE-YEAR CURES IN PATIENTS WITH MICROSCOPICALLY POSITIVE CERVICAL LYMPH NODES REPORTED IN THE LITERATURE, 1927-1942

Radiation Only				Neck Dissection				
Author	Cases Treated	Cases Well*	% Well	Author	Cases Treated	Cases Well	% Well	Primary Lesion
Duffy[31]	68	3	4.4%	Duffy[31]	45	9	20%	Mouth
Clarkson[21]	?	1	?	Morrow[91]	26	3	11%	Tongue
Martin, H.[68]	?	46	?	Fischel[43]	48	17	35%	Mouth and lip
				New[92]	57	8	14%	Tongue
				New[92]	45	11	24%	Jaw
				New[92]	50	18	39%	Lip
				Martin, H.[68]	65	17	26%	Mouth and lip
				Blair & Brown[9]	74	20	27%	Mouth

* All radiated cures received interstitial radon implants.

Cases of subsidence of swollen cervical nodes have been frequently reported following external radiation, but surgeons have often noted that clinically suspicious nodes may prove to be inflammatory on microscopic examination (Table II).

TABLE II

Patients Well Following Radiation of Enlarged Cervical Lymph Nodes (Presumably Without Pos. Nodal Biopsies)

Author	Cases Treated	Cases Well	% Well	Time
Coutard[24]	162	27	16%	5 yrs.
Quick[96]	161	12	7%	?
Engelstad[38] (mouth)	81	5	6%	?
Engelstad[38] (lip)	68	18	26%	3 yrs.
Martin, C. L.[65] (face, lip, mou.)	39	8	20%	4 yrs.
Shreiner & Mattick[104] (lip)	38	8	21%	5 yrs.
Wookey[123] (mouth)	53	0	0%	
Forsell[47] (mouth)	72	0	0%	
Simmons[107] (mouth)	108	0	0%	

Incidence of Negative Microscopic Findings Following Neck Dissections for Enlarged Nodes

Author	Pts. with Neg. Node
Broders[49]	38.5%
Simmons[49]	55%
Duffy[29]	25%
Fischel[43]	28%
Blair, Brown & Womack[5]	35%

Sherwood Moore,[12] of St. Louis, has written: "There may have been cases of cervical gland metastases treated by radiation that have recovered, but offhand I cannot recall an example of it in my experience." Quick's[98] opinion is that: "Complete control of epidermoid carcinoma metastases in the neck is but rarely effected by external radiation alone. Growth restraint only is the expectancy."

It is rare to find any report of five-year cures following irradiation of swollen nodes in which the percentage is higher than the normal expectancy of inflammatory nodes would be.

SURGICAL TREATMENT

The surgical treatment of malignant disease in general leaves much to be desired and it is to be hoped that some day we will have a more efficient method. This hope stimulates continuous investigation and interest, but it

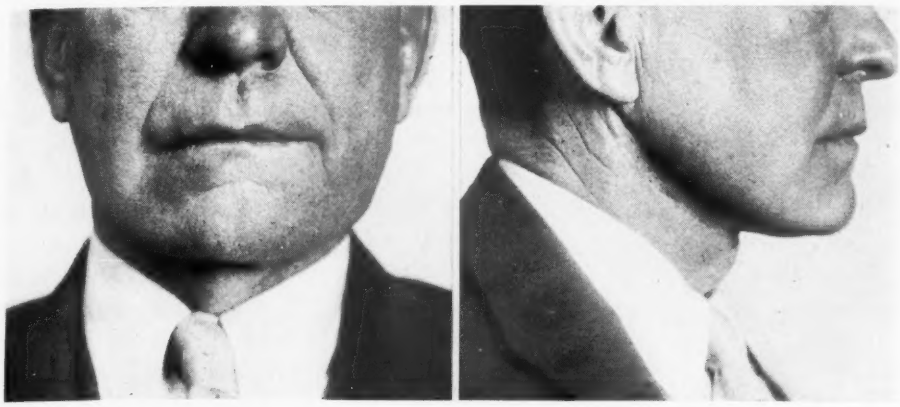

FIG. 1.—Bilateral upper neck dissection in patient who had carcinoma of the lip. Metastases were demonstrated microscopically in the nodes and the patient remains well 11 years after operation. This operation has an extremely low mortality, is not especially disfiguring, and produces a worth while percentage of five-year cures when indicated.

should not lead to the acceptance of inferior or unproven methods. Any treatment supplanting surgery should surpass its known results when meeting the same criteria which have long been applied to the surgical treatment of cancer, namely, the percentage of patients with positive microscopic diagnoses who are living and well five years after the beginning of treatment (Fig. 1).

Block removal of lymph nodes draining the area seems to be an established principle in cancer surgery and their removal from the neck is more anatomically feasible than from other areas. It does not seem logical to have a patient with a carcinoma of the breast in whom an axillary dissection has been done, in one ward, and a patient with a carcinoma of the mouth in another ward, in whom the neck nodes are either not treated, or are treated by some feeble method.

The results of neck dissection have been far from perfect, but a very worth while percentage of cures has been reported from many clinics (Table 1).* The group listed here does not contain all that have been published, but only those in which five-year results were listed and in which the microscopical findings were easily ascertainable. Variations in the percentage cured are probably reflections of differences in the locations and malignancy of the primary lesions, as well as the criteria established for operability and inoperability (Fig. 2).

* Our own series is not reported in this paper as it is rather small and has been published, in part, elsewhere.[9]

CRITERIA FOR NECK DISSECTIONS

It is thought that the rule should be to undertake dissections in patients with primary carcinoma of the lip or mouth. Deviations of care of individual patients are made *away* from this rule, rather than making it a last resort. Exceptions have to be carefully considered. Fixation of the metastases to the skull or vertebral column is a contraindication, but fixation to the lower jaw is not necessarily so, though the percentage of cures will be smaller. Fixation to the common carotid artery or vagus nerve is usually a contraindication, though occasionally worth while results may be obtained (Fig. 3). Widespread involvement of the anterior and posterior triangles on both sides of the neck is a contraindication. Bilateral complete dissections may be undertaken in two stages if involvement of the second side occurs later and the first side has remained well (Fig. 4). Several patients have had a complete neck dissection on one side combined with an upper neck dissection on the other side in one stage, when there has been involvement of the upper neck on both sides and the lower neck on one side. The highly malignant, anaplastic, "lympho-epitheliomas" of the hypo- and nasopharynx and tonsillar region have given poor results surgically and are somewhat radiosensitive, so that they are usually treated by the latter method; this is an excellent contribution for which Coutard[24] deserves much credit. (Surgical excision and neck dissection, as described by Trotter,[119] may be considered in well differentiated lesions of the hypopharynx).

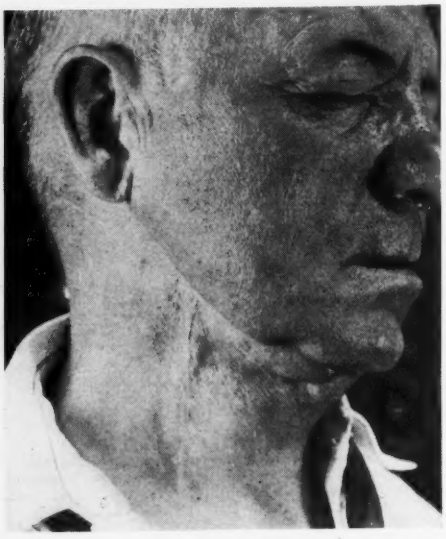

FIG. 2.—Patient well 10 years after complete unilateral dissection for metastatic malignant melanoma (primary site was on the temple). A few weeks after the dissection, a coal-black area of recurrence was present in the skin scar and this was widely excised with the cautery, with subsequent cure.

Probable incurability of an advanced local lesion has been an indication for omitting neck dissection, or at least delaying it until the results of the local treatment can be determined. On the other hand, when it is thought that the local lesion can be eradicated, neck dissection has been done simultaneously or soon after the local treatment without waiting to see the results of the latter. This is at variance with some who believe that the neck dissection should never be done until the local lesion has been cured, but operable neck masses may become fixed and inoperable while awaiting complete retrogression of a local lesion from interstitial radiation, or primary healing following operation.

The general health of the patient is rarely a contraindication to the operation, as nearly all of these patients are over 50 or 60 years of age, and have

varying degrees of arteriosclerosis, heart disease, prostatic obstruction, lowered renal function, *etc.* The mortality is generally below 5 per cent as long as the neck dissection is not combined with an extensive mouth operation.* The operative mortalities with complete dissections have nearly all followed some operation of considerable magnitude for an advanced lesion, such as combining the dissection with a cautery destruction of the jaw or floor of the mouth, or with an upper neck dissection on the opposite side. Successful dissections have been done in controlled diabetics, in patients nearly 90 years of age, and in the presence of advanced heart disease and orthopnea, but the mortality will necessarily be higher in such instances.

A B

FIG. 3.—Complete unilateral neck dissection with resection of right common carotid artery because of huge metastatic squamous cell mass (A) encircling it. Patient awakened in the usual time after the anesthesia and has had no paralysis or other neurological disturbances and works every day. Examination of the specimen showed that the tumor had been compressing the artery. Well now four years after operation (B), though repeated thorough examinations have never revealed the primary site.

Another group in whom dissection is sometimes indefinitely postponed consists of those elderly patients with early, low-grade lip lesions and no enlarged cervical nodes, particularly if satisfactory arrangements can be made for follow-up examination of the neck each month.

Neck dissections have occasionally been done for diseases other than metastatic squamous carcinoma when thorough investigation has failed to reveal any spread beyond the neck. These have included malignant melanoma, lymphosarcoma, and reticulum cell sarcoma, but the prognosis is generally poor in all of these (Fig. 2), and radiation may be better for the latter two. Neck dissections are not done for tuberculosis of the cervical lymph nodes, as radiation therapy seems definitely better.

TYPE OF NECK DISSECTION INDICATED

The purpose of the operation is the removal of any lymph nodes which are, or may be, involved by the disease. Taylor and Nathanson's[113] work on the lymphatic drainage from the mouth and lips serves as an excellent guide

* Hayes Martin[68] has reported 2.7 per cent, and Fischel[43] 3.6 per cent mortality from complete neck dissections, and Figi[41] 0.18 per cent mortality from upper neck dissections.

for determining where the metastases will probably occur. In ulcerated mouth lesions, a further guide is sometimes afforded by the presence of enlarged inflammatory nodes.

In general, a complete neck dissection is done on one side for lesions on the lateral border of the tongue, the buccal mucosa, the lateral portion of the floor of the mouth, or the upper jaw or palate on one side. Alveolar lesions on the lateral aspect of the lower jaw involve the bone nearly always, so that an upper neck dissection combined with cautery destruction of the jaw is usually done. These lesions metastasize rather slowly, but if firm enlarged

FIG. 4.—Bilateral complete dissection for carcinoma of the tongue. The first side was done at the time the tongue was treated and crossed metastases appeared one year later in the carotid sheath, necessitating a complete dissection on the second side. Well seven years after the first side and six years after the second side.

nodes are already present in the neck, a complete neck dissection on that side with a cautery destruction of the jaw may be done, though with an anticipated higher operative mortality.

A bilateral upper neck dissection is usually done for those lesions of the floor of the mouth, or alveolus which approach the midline, unless there are already enlarged firm nodes on one side, in which case a complete dissection on that side and an upper neck dissection on the opposite side may be done, again with a higher operative mortality. The same rule is applied to carcinomas of the lower lip, that of regional node removals, usually doing a bilateral upper neck dissection as nearly all of these lesions approach the midline, but doing a complete operation on one side when the lesion is near the angle of the mouth and when enlarged, hard nodes are already present on that side.

The complete neck dissection is done much as described by Crile,[25] in 1906, with a few modifications. Its purpose is to remove as much of the lymphatic-bearing tissue as possible. The area of excision extends superiorly along the body of the lower jaw through the tail of the parotid to the mastoid; posteriorly along the border of the trapezius muscle; inferiorly across the top of the clavicle; and anteriorly up along the ribbon muscles to the hyoid and

then across the midline to the opposite side of the chin. The block excised contains the subcutaneous fat and fascia, the sternomastoid muscle, internal jugular vein, the submaxillary gland and part of the parotid, and extends internally to the ribbon, scaleni, levator scapulae, trapezius and mylohyoid muscles. The carotid arteries are left intact as well as the vagus and 12th nerves (though the ansa is removed) and often the portion of the 11th nerve supplying the trapezius is not removed if involvement in that area is not expected (Fig. 5). By separating the stylohyoid and digastric muscles from the hyoid, and dividing the digastric tendon, it is possible to remove the entire block from the clavicle to the head in one piece, and it is desirable to keep any involved nodes deep within the excised tissue and not expose them.

Upper neck dissections are usually done bilaterally and do not include removal of the sternomastoid muscle or jugular vein. An incision is made from one mastoid to the other, crossing the midline of the neck just above

A B

FIG. 5.—Showing the effect on shoulder action of saving the 11th nerve. (A) Complete dissection in a young woman with preservation of the 11th nerve. (B) "Shoulder-drop" in another patient in whom the 11th nerve was not preserved because of palpable nodes in the region. Also shows effect of preserving the lower branch of the seventh nerve in the first patient.

the hyoid and the superior flap is reflected upward on the face. The inferior flap is retracted downward in the region of the carotid sheath and the deep superior cervical nodes are removed by dissecting the sheath (and its included fat and lymphatics) upward, beginning about one inch below the carotid bifurcation. After the upper carotid sheath has been cleaned out, the dissection is carried upward on the surface of the mylohyoid and sternomastoid muscles to the body of the mandible and to the mastoid. The contents of the submaxillary triangle are included in the excised block together with the tail of the parotid. The 12th and lingual nerves are not removed, but the lower branch of the 7th nerve is removed.

TREATMENT OF THE NECK IN MOUTH AND LIP CARCINOMA WHEN THE NODES ARE NOT ENLARGED

Though many agree that a block neck dissection is the best treatment when there are enlarged nodes in a patient with mouth or lip carcinoma, there is some difference of opinion in regard to the therapy for a similar patient in whom the nodes are not clinically enlarged. It is thought that the terms "prophylactic" radiation or "prophylactic" neck dissection are not par-

ticularly good ones, as small nodes may possibly harbor small metastases (Table III).

TABLE III

INCIDENCE OF MICROSCOPICALLY POSITIVE NODES FROM PATIENTS WITHOUT CLINICAL ENLARGEMENT

Author	Pts. with Positive Nodes
Kennedy[59] (lip)	14%
Simmons[59] (mouth)	34%
Morrow[91] (tongue)	39%
Phillips[59] (buccal)	51%

In addition to the microscopic findings listed in Table III, Duffy's report from Memorial Hospital indicates the clinical developments in such patients. In a series of 252 carcinomas of the tongue seen there, 78 had enlarged cervical nodes when first seen. The remaining 174 received no treatment to the neck and during the subsequent period of observation, 23 developed inoperable and 48 developed operable cervical metastases.

The choices of treatment when the nodes are not clinically enlarged are radiation, surgery, or the "wait and see" treatment (aptly named by E. S. Meyers[88]).

In these patients about the only form of radiation that is available is external treatment. Figi[41] reported 287 patients with lip carcinomas who had no enlargement of the cervical nodes. Ninety-five patients received no treatment of any kind to the neck, and in this group there were 75 per cent five-year cures. One hundred ninety-two patients received "prophylactic" radiation to the neck, and in this group there were 73 per cent five-year cures. In a large similar group in which neck dissections were done, there were 89.74 per cent five-year cures. Shreiner and Mattick[104] divided their patients with nonpalpable cervical lymph nodes into two groups—those with small local lesions and those with large local lesions. In half of each group, no treatment was given, and in the other half of each group extensive cervical radiation was employed. They reported exactly the same percentage of cure in the two halves of each group—85 per cent in each of the small local lesion groups, and 58 per cent in each of the large local lesion groups.

Neck dissection should be the rule to follow in patients with carcinoma of the lip or mouth who have no clinical enlargement of the nodes, as a considerable number of them will have definite metastases, and there is at present no satisfactory way of differentiating them. If any group is to be treated by the "wait and see" method, it is probably safest to do it in very early, low-grade, lip lesions where the incidence of metastases is lowest. Extreme age, poor general health, and ready availability for repeated examinations of the neck may be further extenuating factors, but one should be cautious even with these in omitting dissections in carcinomas of the tongue or floor of the mouth, in which the incidence of metastases is high.

SUMMARY

At the present time, block surgical excision of the lymphatic-bearing areas of the neck gives the best prospect of cure in the greatest number of patients with metastatic carcinoma of the cervical lymph nodes. Lack of clinical enlargement of the lymph nodes does not necessarily mean that no metastases are present, and most of the patients in this group should not be denied the improved prognosis that neck dissection may offer. The operation has a low mortality in itself, and produces a percentage of five-year cures that is worth while.

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CONGENITAL ATRESIA OF THE ESOPHAGUS, WITH TRACHEO-ESOPHAGEAL FISTULAE*

TRANSPLEURAL OPERATIVE APPROACH

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THE EARLIEST RECORD of congenital esophageal atresia is that by Thomas Gibson who, in a book on anatomy published in 1703, tells of observing a case in 1696 and following it to autopsy. Mackenzie[1] quotes Gibson's treatise on the case. In 1880, Mackenzie found 42 cases in the literature. By 1919, Plass,[2] in an exhaustive review of American and foreign literature, verified 149 cases. Rosenthal[3] brought the number to 255 cases in 1931, and now there are over 300 cases on file.

Vogt,[4] in 1929, emphasized the need of progress in the treatment of the condition and formulated the first comprehensive classification of esophageal anomalies. He divided them into three groups. The first is complete absence or agenesia of the esophagus and is quite rare. The second group includes those cases which show a blind upper and a blind lower segment neither of which communicates with the trachea. The third group includes those anomalies which give fistulous communication to the trachea. Type 3A has a blind lower segment but the upper segment opens into the trachea. The common Type 3B has a blind upper segment with a tracheal fistula from the lower segment. In Type 3C both segments communicate with the trachea. Type 3B comprises 70 to 80 per cent of reported cases.

The symptoms are constant and diagnostic. The infant drools excessive amounts of mucus and saliva. He is subject to frequent attacks of choking and cyanosis, and these are precipitated by the taking of fluids by mouth. The latter are immediately regurgitated and partially aspirated so that an episode of choking and cyanosis follows each attempt at feeding. In Types 1, 2 and 3A, a plain film will show absence of gas in the bowel while Types 3B and 3C show its presence.

A soft rubber catheter is of considerable diagnostic aid. When inserted down the esophagus it reaches an obstruction 10–12 cm. from the anterior alveolar margin. The inadvisability of use of contrast media, such as barium, is agreed. Its use results in overflow aspiration, and an irritative pneumonitis. Lipiodol or diodrast may be instilled into the esophagus and a roentgenogram made, but the lipiodol should be immediately aspirated. Types 3A and 3C may not otherwise be diagnosed.

The anatomy of the condition varies of course with the type of anomaly but in the common Type 3B it invariably shows a constant pattern. Plass[2]

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compiled measurements of recorded cases and showed the upper segment to be most frequently 3 to 4 cm. in length from larynx to blind end. The fistula opens into the trachea commonly within 1 cm. of the bifurcation but may open 2–3 cm. above the carina. In a very few recorded cases the fistula opened into a bronchus. The fistulous opening is usually 2–4 Mm. in diameter but may be considerably attenuated. The muscular coat of the esophagus may or may not be continuous over the atretic portion. The proximal segment is always dilated and hypertrophied to perhaps four times the size of the distal segment, which usually measures 3–10 Mm. in diameter.

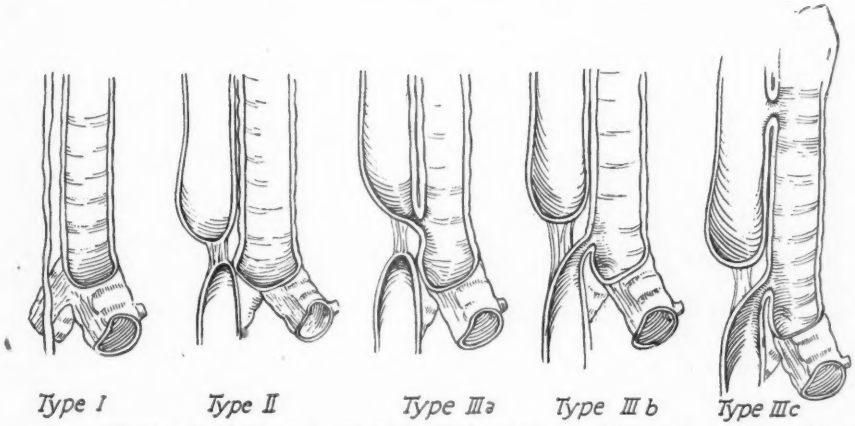


FIG. 1.—Vogt's classification of congenital atresia of the esophagus and tracheo-esophageal fistula illustrated.

The normal esophagus below the fistula is 1 cm. in diameter. In most cases the segments are separated by a distance of 1 cm. but extremes may lap over or be separated 5 cm. There are on record a few cases of very small tracheo-esophageal fistulae in otherwise normal people that were well tolerated into adult life.

Associated anomalies are rather common. Plass[2] found about half of the recorded cases to show them. Imperforate anus was present in 25 per cent of the cases. In only rare instances are the associated anomalies incompatible with life.

The embryologic explanation of esophageal anomalies is a much confused subject. The normal pulmonary anlage differentiates from the primitive foregut as a tiny, ventrally placed mass of entoderm seen first in the 3 Mm. embryo just caudal to the pharyngeal pouches. By the 4 Mm.-stage the anlage has grown in a caudal direction so that two lateral longitudinal grooves are formed in the wall of the foregut and their internal elevation is a septum which begins to separate the foregut into a posterior gullet and an anterior trachea. The separation is complete at the 11 Mm.-stage.

Just why the separation of the trachea from the foregut should result in atresia and fistula in some cases is an enigmatic problem. The constant pattern of the anomaly makes any theory of chance embryonic infection of trauma untenable and one looks to an early (before 11 Mm.) alteration

in the growth process for the explanation. That the change may be genetic is evidenced by Mackenzie's case, where a man fathered three infants, all with the anomaly, by different wives.

Three theories usually are given to explain the anomaly. The esophagus is, at one stage of its growth, a solid bar of tissue. Cessation of growth at this stage would result in a condition simulating atresia. This theory is untenable because the solid bar stage does not appear until the 20 Mm.-stage, after the esophago-tracheal anlage is well formed (4–6 Mm.).

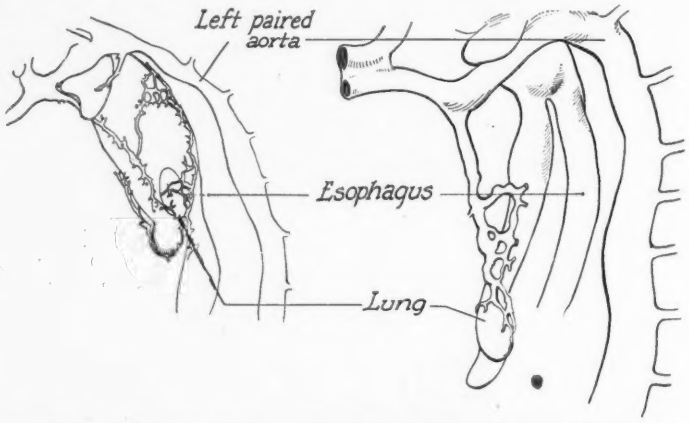


FIG. 2.—Drawing showing embryologic development of esophagus and trachea in (a) 4 Mm. embryo and (b) 11 Mm. embryo (modified and from Rosenthal).

The second theory assumes that the lateral septa deviate posteriorly to fuse with the dorsal wall of the foregut resulting in an atresia. Failure to fuse one lateral septum with its mate would conceivably result in a fistula. Deviation of the septum could be brought about by variations in pressure within the embryo by an enlarged heart, anomalous vessel, *etc.*

Rosenthal[3] believes the crux of the explanation to lie in altered cell growth along the lateral septa and not on mechanical deviation. Thus, deficient or absent growth of the septa would result in fistula while deficient growth of entodermal cells of the dorsal wall of the foregut would result in atresia of the esophagus. The earliest known simple anomaly of this type is in an 18 Mm.-embryo in the Harvard collection.

The trends of surgical treatment of esophageal anomalies are mirrors of surgical and anesthetic progress as a whole. If untreated these unfortunate infants rapidly lose 25 to 40 per cent of their weight, according to Brenneman,[5] and die almost routinely within one week. Attempts at feeding by gastrostomy were common from the time that Charles Steele[6] first performed gastrotomy on a case in 1888. This method and jejunostomy, which was advocated by Brenneman[5] in 1913, were unsuccessful because the stomach contents invariably regurgitated into the lung *via* the fistula. Richter,[7] in 1913, advocated ligating the fistula transpleurally and gastrostomy with repair of the esophagus at a later date. These cases were failures because regurgitation occurred from the blind proximal segment. Von Hacker,[8] in 1926,

advocated use of the Murphy button to form a direct anastomosis, but was never successful.

Mixter[8] realized, in 1929, the failure of gastrostomy as a treatment and began using a cervical esophagostomy combined with extrapleural ligation of the fistula and exteriorization of the distal segment as a dorsal esophagostomy. By 1936 he had decided that this method was a failure and turned to a more direct approach.

Leven,[9] in 1936, advised exteriorization of the cardiac esophagus and stomach and gastrostomy in the distal portion of the stomach but abandoned the method in 1940[10] in favor of a long range four-stage attack involving

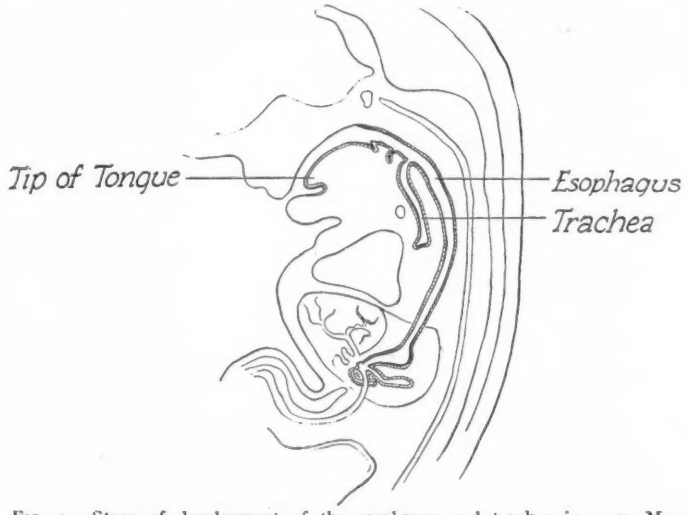


FIG. 3.—Stage of development of the esophagus and trachea in a 17 Mm. embryo (modified and from Arey).

first, gastrostomy; second, extrapleural ligation of fistula; third, cervical esophagostomy; and fourth, antethoracic esophagoplasty at a later date. He had an infant upon whom he had performed the first three stages alive one year and seven days at time of publication.

Gage and Ochsner,[11] in 1936, recommended cervical esophagostomy and ligation of the cardiac esophagus and gastrostomy. This allowed accumulated secretion of the distal esophageal segment to overflow into the trachea, and was unsuccessful.

Gamble,[12] in 1938, suggested a method, similar to Leven's, in which he divided the cardiac end of the stomach leaving the proximal end open for drainage of the distal segment of the esophagus and performing a gastrostomy in the distal stomach. A cervical esophagostomy was also established.

Carter,[13] in 1941, advocated an indirect approach, wherein he performed a cervical esophagostomy and then by abdominal operation exposed the cardiac esophagus and pulled down as much as possible of it before placing a ligature about the esophagus and dividing it bringing out the distal segment of an antethoracic esophagostomy. His patient lived 62 days.

By 1936 the failure of the indirect approach to the problem had become

evident, and burdened with the added problem of antethoracic cutaneous esophagoplasty, it has been criticized by many surgeons. Lanman[8] began performing primary anastomoses by the extrapleural route in Boston in 1936. All of his patients succumbed, but two lived eight and nine days, respectively.

Haight and Townsley[14] have recently reported a successful extrapleural anastomosis with the child then two years of age, which, so far as I know,

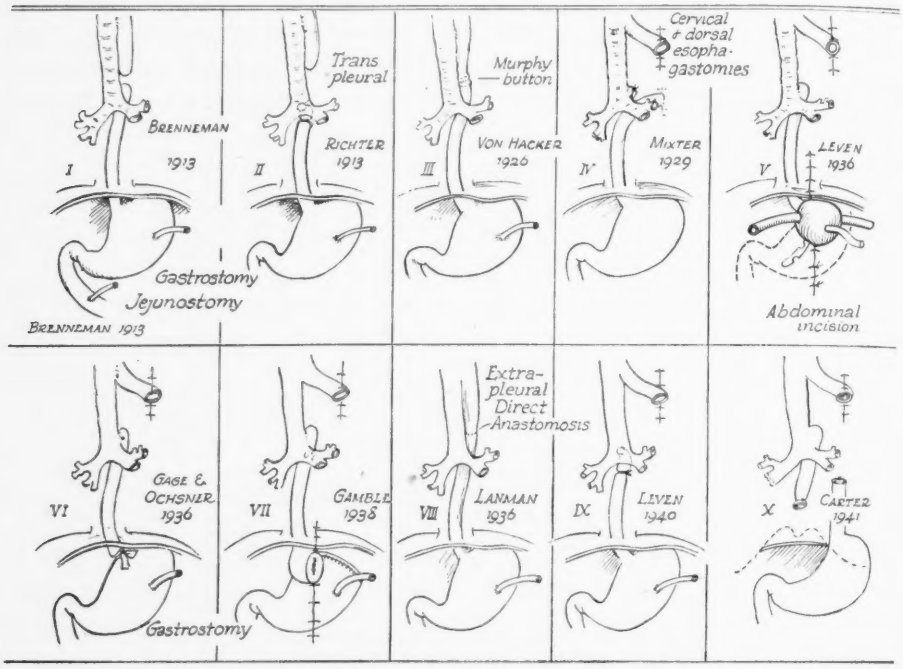


FIG. 4.—Types of operative procedure utilized or proposed in the treatment of tracheo-esophageal fistula.

is the only successful case of restoration of the esophagus, and the patient survived that long. It is true that there was not a primary union of the anastomosis since the wound broke down, and an esophageal fistula developed which subsequently closed spontaneously. The trend has been more and more to primary anastomosis and several technics have been advocated. Lanman and Mixter,[8] Leven,[9, 10] Haight,[14] and Shaw and Sampson[15, 16] practice an extrapleural approach to the lesion, while Richter,[7] Churchill,[8] and the authors, advocate a transpleural approach. Sampson and Shaw suggested, in 1938, that anastomosis is easiest over a rubber urethral catheter size F. 12 to F. 15.

Four of these unfortunate children have been treated in the John Sealy Hospital during the past three years.

CASE REPORTS

Case 1.—Male, with a tracheo-esophageal fistula, Type 3B. On August 4, 1940, the third day of life, a gastrostomy was performed. The child lived 48 hours, and died of bronchopneumonia.

Case 2.—R. E. W., male. Type 3B. This child was operated upon by Dr. E. J. Poth. August 14, 1942, the seventh day after birth. Posterior extrapleural operation, in which the esophageal fistula was ligated. The child lived for three days.

Case 3.—This was the first child operated upon transpleurally. The success of this procedure prompts us to report it in detail.

D. G. H., male, born at St. Mary's Infirmary, March 28, 1943, weighing 7 lb. 8 oz. On the fourth day a diagnosis of atresia of the esophagus and tracheo-esophageal fistula was made roentgenologically, showing the presence of gas in the stomach and intestines. A barium mixture was used to outline the proximal esophagus. It was thought to be Type 3B (Fig. 5). Parenteral fluids were given, with repeated transfusions. Because

FIG. 5.—D. G. H. showing gaseous distention five days after birth.

of the failure of surgical treatments in previous cases the pediatrician in charge had little hope of relief for the child. On the 14th day surgical consultation was had with one of us, and we offered little encouragement from surgery, with no recorded cases of cure, to our knowledge, at that time. Because the parents insisted that some effort be made, surgical relief was attempted. Though the child was 15 days old and had had nothing except parenteral fluids, with blood, it seemed in fair condition.

Our plan of treatment was determined largely by our experience with resection of the middle portion of the esophagus for carcinoma, and with the impression that intrapleural operations are tolerated much better than is generally thought. We decided to approach the esophagus transpleurally, hoping to be able to close the fistula and effect an end-to-end anastomosis of the esophagus. If the anastomosis was not possible, we planned to close the lower end of the esophagus and bring the upper segment out the neck, as is done after resecting the esophagus for cancer, later dealing with the problem of an extrathoracic esophagus.

Operation.—April 12, 1943: Under local anesthesia, a gastrostomy was performed. Air but no fluid was in the stomach. The gastrostomy tube was left open to keep the stomach empty of air and prevent any regurgitation up the esophagus during the operation. The child was given a general anesthetic and placed on his left side, then an incision was made in the 5th intercostal space from near the vertebra to the sternum in front. The ribs were spread apart with a Gelpi retractor, the lung collapsed by compression and retracted forwards and downwards. The defect in the esophagus was

FIG. 6.—Baby L. showing gas in intestines and lipiodol outlining blind proximal esophagus.

easily recognized beneath and slightly above the crossing of the azygos vein. The azygos vein was doubly ligated and severed. The pleura was incised over the esophagus, above and below. A ligature was passed beneath the esophagus above and below the defect. These were used for traction. The esophagus was lifted out of its bed in the defective area, leaving the lower end attached to the trachea by the fistulous communication. The lower segment narrowed gradually to the fistula and here was about 5 Mm. in diameter. A fine silk suture was passed through the fistula, near the trachea, and then a narrow clamp was applied a short distance away from the trachea and the fistulous tract cut across. The tracheal side of the fistula was closed with the suture previously introduced.

At this time the question arose as to whether or not our original plan of closing the lower end of the esophagus and bringing the blind end up through the neck should be attempted. To subject an older person with carcinoma of the esophagus to a cervical esophageal fistula seemed quite all right, but to subject a young child to a fistula with the prospects of going through life with some type of an extrathoracic esophagus seemed hardly justifiable, even though a life might be saved.

After liberating the esophagus almost to the diaphragm, being careful not to sever the circulation to the esophagus on its vertebral side, and also freeing the upper end of the esophagus high up into the neck the two ends apparently could now be approximated

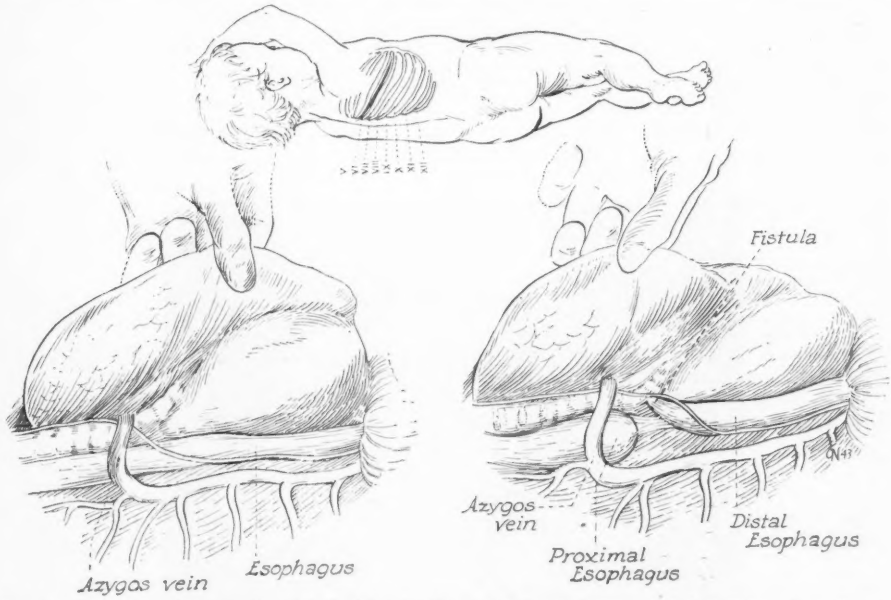


FIG. 7.—Transpleural approach. (a) Incision in the 5th intercostal space. (b) Position of esophagus. (c) Illustrating deformity in D. G. H. before anastomosis.

for an anastomosis. This liberation seemed to give at least 1–2 cm. more length and the circulation of the two ends seemed adequate. The opening in the lower segment was enlarged to about 0.6 cm. A No. 7 ureteral catheter was passed through the nose down into the upper blind segment of the esophagus outlining its lowest part. This end was opened for a distance of about 1 cm. over the point of the catheter. The catheter was passed on into the lower segment and into the stomach. The catheter served to define the lower end of the upper segment and was left in the stomach so that it may be recovered from the gastrostomy opening and serve to pass a string through the esophagus for dilatation to prevent stricture. The two ends of the esophagus were sutured together over the catheter with a continuous No. 000 chromic catgut (made on needle) suture "eye suture." The stitch was a continuous running stitch interrupted by locking on opposite sides of the esophagus. The anastomosis seemed to be secure with this stitch (Fig. 7). To relieve tension on the suture line, two stitches above and two stitches below were inserted passing just through the muscular coat of the esophagus and anchored to the pleura. The lung was then expanded by massage and intratracheal pressure. The chest wall was brought together with interrupted No. 0 chromic sutures passing above and below the adjacent ribs. The muscles were carefully sutured together, as well as the skin. An extra effort was made to have the lung completely expanded when the airtight closure was made (Figs. 8 and 9).

The patient's convalescence was smooth, showing very little shock. He was kept

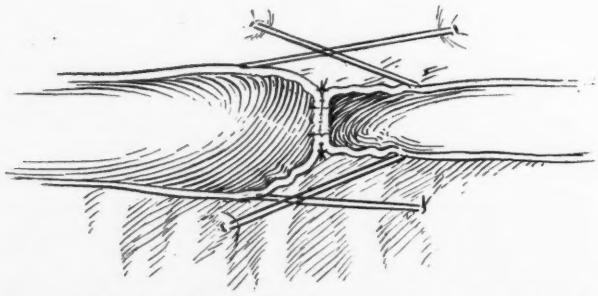


FIG. 8.—Stitches applied subsequent to anastomosis to relax tension on suture line.

in an oxygen tent for ten days. Transfusion was given subsequent to the operation and also parenteral fluids for several days. The ureteral catheter was fastened in place and allowed to remain for a period of 12 days when it was recovered from the stomach

FIG. 9.—D. G. H., postoperative roentgenogram showing ureteral catheter through the esophagus and gastrostomy tube in place.

through the gastrostomy opening under the fluoroscope and a large braided silk thread was pulled through the esophagus and out the gastrostomy opening, the two ends of the string being tied together. The purpose of this thread was for bougie dilatation of

the sutured area to prevent stricture. After a period of three weeks bougies were passed at intervals, and size No. 18 passed easily (Fig. 10).

Though bougies passed easily through the anastomosis, still the child had difficulty in taking nourishment by mouth, the effort being accompanied by some strangulation and coughing, and, as has been previously stated, on several occasions he developed high temperature with physical signs of pneumonia, usually in the left lung, as confirmed roentgenologically. By stopping mouth feeding and substituting gastric feeding and the administration of sulfonamides, he recovered and proceeded to gain weight.

When the child was about seven months of age someone inadvertently cut the string which was used for dilatation. It might have been possible to leave it out at this time but thinking further dilatation might be necessary, one of us attempted to replace the string. A very small piece of lead was placed on the end of a thread and brought from the mouth through the nose, the leaded end being left in the pharynx with the idea that the thread would be passed into the stomach where it could be recovered and the large string replaced. Two days subsequently a roentgenogram showed the piece of lead at the upper end of the esophagus (Fig. 11). We attempted to withdraw it but were surprised to find it held fast. Several attempts were made to pull the thread back but it would not give way. Then the thread was cut off, allowing it to go into the pharynx, hoping that the lead would pass on into the stomach. Then we passed the ureteral catheter through the nose into the stomach and recovered it as we had before replacing the string.

Following this the child seemed to have difficulty swallowing and had repeated attacks of strangulation. A week later he developed an active pneumonia from which he died on November 14, 1943, age seven months and 21 days.

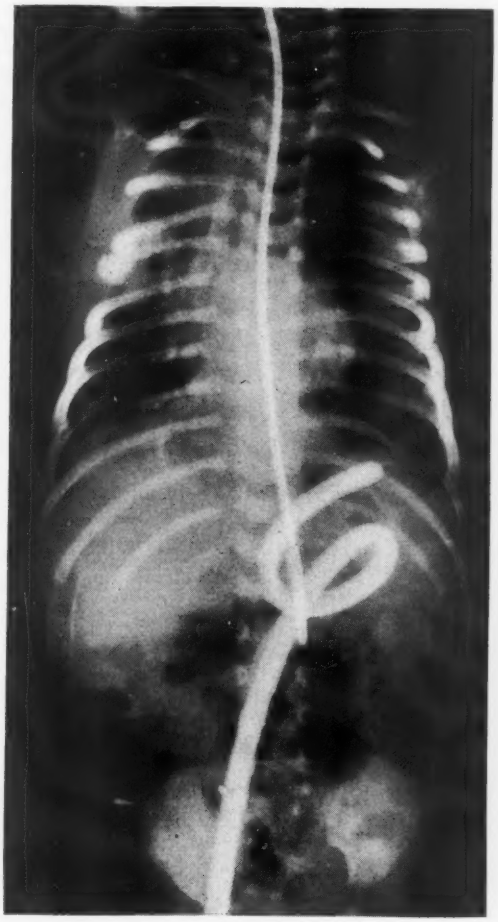


FIG. 10.—D. G. H. postoperative roentgenogram showing ureteral catheter through the esophagus and gastrostomy tube in place.

Autopsy revealed the lung firmly adherent to the pleura throughout the right side of the chest, the left pleural cavity being free of adhesions. Union of the esophagus was excellent, with an opening 1 cm. in diameter (Fig. 12). But to our surprise there was an opening between the trachea and esophagus at the level of the cricoid cartilage, and the thread with the piece of lead attached was fastened in a very complicated way through the fistula and around the cartilage. The explanation for this situation was very puzzling. We were at a loss to explain how such a small piece of lead could perforate through the tracheal and esophageal walls, but a more careful examination showed

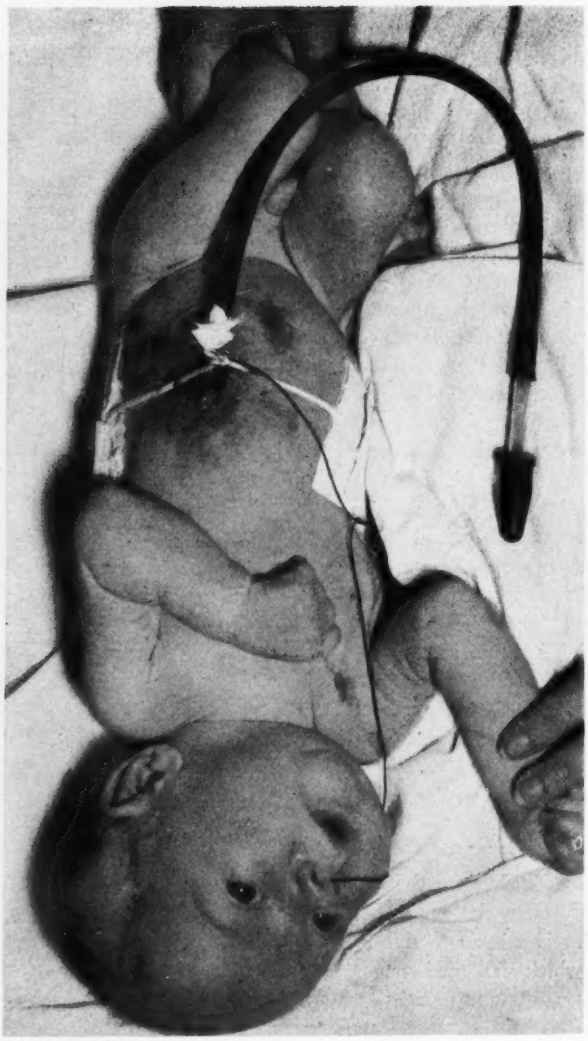


FIG. 11.—D. G. H., postoperative three months with gastrostomy tube and string for dilatation through the nose, esophagus and stomach, and our gastrostomy opening.

there was a vertical communication 1 cm. long just below the cricoid cartilage. Upon examining the specimen more closely, one end of this tear for a distance of 4 Mm. was evidently another congenital fistula (Figs. 13 and 14). We feel quite confident that this second fistula was present all the time, and that this piece of lead passed through this fistula and became entangled, resulting in further enlargement of the fistula and subsequent death of the child. The explanation of the difficulty of swallowing, with repeated attacks of aspiration pneumonia during his convalescence, can be explained satisfactorily by the finding of the second tracheal fistula in the upper segment of the esophagus. This would place this case in Vogt's classification of Type 3C. The undiagnosed fistula being high in the neck could have been easily closed if it had been diagnosed.

Case 4.—This was a female, Baby L. born November 6, 1943, and operated upon the third day after birth. This child was premature, weighing only 5½ lb. and was very weak (Fig. 15). It also had a deformity of the rectum in which the rectum opened into the vagina. Any operative treatment seemed very hazardous. A transpleural approach was made and the Type 3B deformity was found. The azygos vein was ligated. The communication of the lower end of the esophagus was just at the bifurcation. The blind upper end of the esophagus was high, some 3 cm. distance between the two ends. The fistulous tract was ligated with silk and an effort made to approximate the

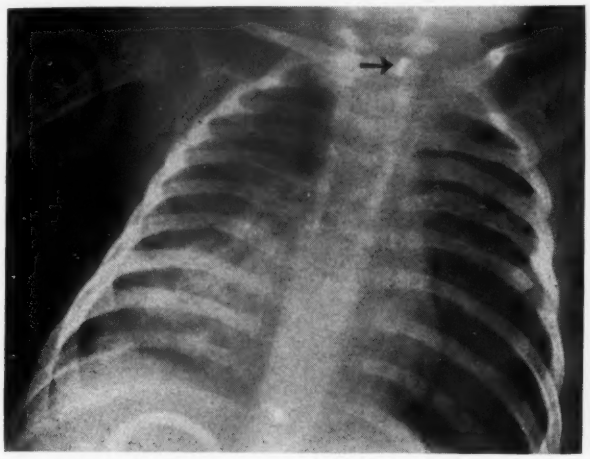


FIG. 12.—D. G. H. showing small piece of lead fastened in upper esophageal fistula.

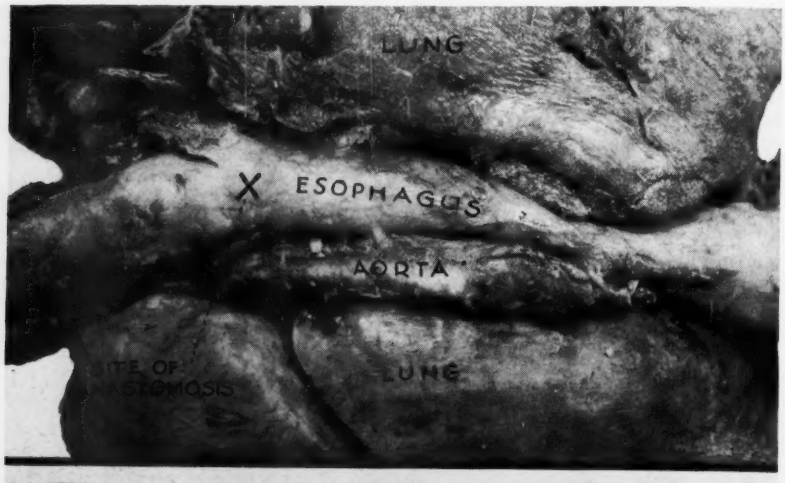
two ends of the esophagus. Because of the distance in the very small child and the very small structure, this was impossible. In an effort to secure more length, the esophagus was liberated from the diaphragm and the stomach pulled partially through the opening. Even this did not give sufficient length. Further effort was made to fix a bile duct vitalium tube into the gap between the two ends. The tube was more than one inch long, but it was too short to bridge the gap. After the excessive amount of trauma, the only alternative left was to bring the upper end of the esophagus up through the neck and close the lower end, and this was done. In addition, a gastrostomy was performed with a No. 14 rubber catheter. The child lived 12 hours.

The operation was unnecessarily long and the child might have lived if our judgment had been better and we had performed a cervical esophagostomy in the beginning.

DISCUSSION.—In an effort to save the lives of these unfortunate children, many plans have been devised for surgical treatment, all of which have been rather universally unsuccessful. They occur sporadically and few surgeons have an opportunity to treat a large number. It is self-evident that after

closing of the tracheal fistula the restoration of the esophagus is of extreme importance. There is no satisfactory substitute for the esophagus even though many attempts have been made to construct one. To condemn a child to a life with an artificial esophagus is a grave responsibility and may not be

FIG. 13



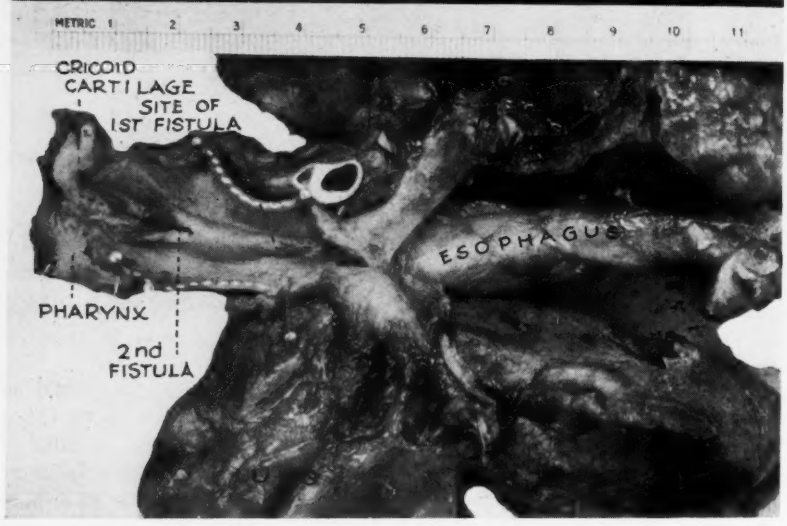


FIG. 14

FIG. 13.—Autopsy specimen. Esophagus from behind. (X) Anastomosed area.
FIG. 14.—Autopsy specimen. Anterior view of trachea opened down to bifurcation, showing site of fistula and site of second fistula.

justified. Efforts heretofore to restore the esophagus have been made extrapleurally and with one exception they have all failed (Haight[14]). With this information in mind the transthoracic approach to the pathology was decided upon and I think the results justified the assumption that it is a preferable route. Opening of the thorax is probably a less severe procedure than the operation which is done extrapleurally and it can be done more quickly.

In the latter procedure infection invariably occurs and tearing of the pleura with its accompanying consequences is difficult to avoid. One can much more easily liberate the esophagus and get the ends closer together through the transpleural approach, but the greatest advantage, I am confident, is that the chance of union of the anastomosis is much greater with the transpleural operation than with the extrapleural. When the lung is expanded following anastomosis the sutured area is thoroughly splinted by the visceral pleura of the expanded lung and within a very short time is firmly sealed off by pleural adhesions. This results in the anastomotic area being soon reinforced with collateral circulation, making union much more certain than it would be with an anastomosed esophagus left in the dead spaces of the extrapleural wound which will naturally fill with blood clot. Taking advantage of the principles used in intestinal suturing of depending upon the power of the peritoneal surfaces to become rapidly adherent should not be

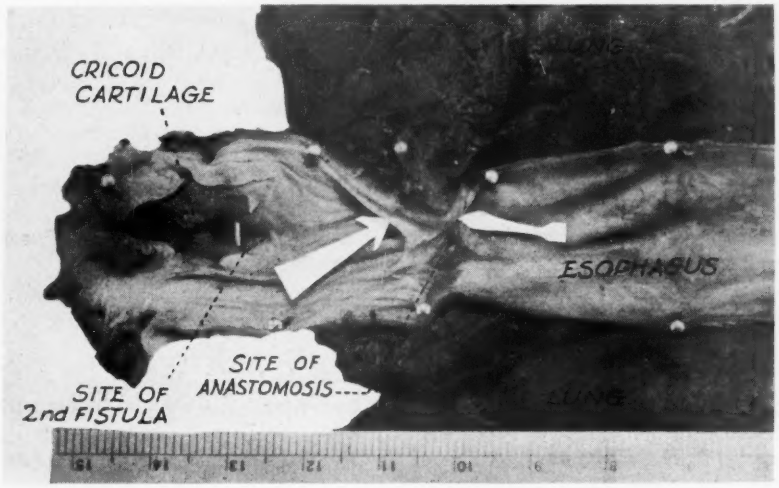


FIG. 15.—Posterior view of esophagus opened showing (a) site of anastomosis (b) second fistula with tearing due to lead and thread.

overlooked in the pleural cavity. Pleural surfaces have this power of adhesion and also the power of resisting infection just as peritoneal surfaces have. We can depend upon the expanded lung forcing the visceral and parietal pleural surfaces in contact with the esophagus to further assure sealing off of the sutured lines and assuring union. Certain cases will not lend themselves to primary anastomosis, particularly if a distance of over 2 cm. separates the upper and lower esophageal segments. Only in these cases should the indirect attack be used. We believe that every case should be explored transpleurally, with ligation of the fistula and a primary anastomosis if technically possible. If the two esophageal segments are too widely separated the fistula should be ligated, and a cervical esophagostomy and a gastrostomy performed. In this indirect approach the antethoracic cardiac esophagostomy of Carter[13] appears particularly attractive for this procedure as it would shorten considerably the length of cutaneous esophagoplasty necessary at a later date,

but it is not wise to attempt this procedure at the primary operation. We are strongly of the opinion that the above reasons are sufficient to recommend the transpleural operation over the extrapleural.

CONCLUSIONS

The history of congenital esophageal atresia and tracheo-esophageal fistula is one of long and repeated failures in efforts which have been made to solve the problem. A partial solution seems near if an early and accurate diagnosis should be made. Time should be taken to prepare the patient for operation even though this may take several days. Transpleural approach to the deformity does not carry great hazards as are usually attributed to it but it does give one a much better opportunity of relieving the condition than the extrapleural approach. Our experience leads us to believe that a primary anastomosis of the two segments of the esophagus can be made in many instances, and this, by all odds, is the most desirable. When the lengths of the segments will not permit anastomosis, cervical esophagotomy and occlusion of the lower end is the next alternative, and in either instance, a preliminary gastrostomy should be done.

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DISCUSSION.—DR. ALFRED BLALOCK, Baltimore, Md.: This paper by Doctor Singleton is quite interesting. It is extremely unfortunate that this child should have been lost after having done so nicely for a number of months following this difficult operation. I am sure Doctor Singleton will be the first to admit that he was fortunate in having a patient with atresia of the esophagus who was in good condition at the time of operation, which was not performed until 16 days following birth. He was fortunate also in that the esophagus was long enough for a primary anastomosis between the two ends. Unfortunately, such is not always the case. The reason for my discussion is to raise the question as to whether one is warranted in attempting a primary anastomosis.

I would like to show Doctor Singleton's first slide. As he stated, the most common type of abnormality is that in which the upper end of the esophagus ends blindly and there is a communication between the lower end of the esophagus and the trachea. Approximately 14 months ago I saw a newborn infant with this type of abnormality, and carried out the procedure described by B. N. Carter, which is a modification of that described by Ochsner and Gage. Under local anesthesia, the upper end of the esophagus was brought out through an incision in the neck. An abdominal incision was then made under local anesthesia, the esophagus was doubly ligated at the diaphragm and the lower end of the esophagus was anchored to the skin of the abdominal wall. This left a short segment of the esophagus in communication with the trachea. The question arose as to whether or not the child would have difficulty as a result of this communication, and I can only say that there has been no evidence of this as yet. Doctor Longmire and Doctor Ravitch have not as yet completed the reconstruction of a tube, but the child is in excellent condition. Some months ago Doctor Reinhoff had a similar case and the procedure which was performed differed only in that the vessels at the upper end of the stomach were divided, and this allowed Doctor Reinhoff to place the upper part of the stomach beneath the skin of the anterior wall of the chest. As a result of this latter maneuver the defect which needs to be bridged by some sort of plastic procedure is only several inches in length.

Despite the encouraging results which have been reported by Doctor Singleton, Doctor Haight, and others, I am inclined to believe that one should use a multiple-stage type of reconstruction for atresia of the esophagus rather than a primary anastomosis between the two ends of the esophagus. The procedure described by Doctor Carter can be performed quickly under local anesthesia, and it is my impression that there will be more survivals when this type of operative therapy is carried out than when a primary anastomosis is performed. I realize in saying this that the ideal type of operation is that which Doctor Singleton is describing.

DR. ALTON OCHSNER, New Orleans, La.: The importance of this subject is not appreciated. Doctor Gage, a number of years ago, emphasized early diagnosis. Until we can get obstetricians cognizant of the fact that it is a matter of early diagnosis we cannot do much about correcting it. Doctor Gage suggested that every baby should have a catheter passed into the esophagus at the time of birth in order to detect a possible obstruction. He insisted on this being done in his own children.

Whereas the usual anomaly is an esophageal atresia combined with a tracheo-esophageal fistula, other types do rarely occur, as shown by Doctor Singleton. Recently, we have had a patient who had no atresia but who had two fistulae between the esophagus and the trachea. Unfortunately, only one was recognized antemortem; only one was closed.

I must disagree with Doctor Blalock that relief of the atresia is not necessary. We are convinced that the accumulation of salivary and other secretions in the blind pouch results in spillage into the trachea, predisposing to bronchitis and bronchiectasis. Even though the reconstructive procedure is one of considerable magnitude in such a young infant, it is unquestionably the best method of therapy.

Although Doctor Singleton operated upon his patient through the right hemithorax,

he did not emphasize the desirability of this approach, which I think is extremely important. Cameron Haight, of the University of Michigan, has operated upon a large number of these, I believe about 20, and according to his published reports, he has explored them all through the left hemithorax. From our experience with extirpation of the esophagus for carcinoma, we are convinced that the approach from the right side is preferable to that on the left. We have done the reconstructive procedure in three patients with esophageal atresia and tracheo-esophageal fistula, two of whom were operated upon through the left hemithorax and one through the right. One operated upon through the left hemithorax was accomplished relatively easily. The other was extremely difficult, however, because of the fistula beneath the arch of the aorta. Although we attempted, as Haight suggested, to mobilize the aorta by ligation of the first intercostal artery this did not give sufficient room to facilitate the anastomosis. Since the esophagus is more on the right than on the left in this area, we believe that the approach from the right side is preferable to that from the left; and in the one case which we operated upon through the right hemithorax the procedure was relatively simple.

I think it is perfectly remarkable that Doctor Singleton was able to accomplish what he did in his case after 15 days, because most of the patients with this condition die as a result of aspiration pneumonia. It is for this reason that the diagnosis must be made early, before the aspiration has occurred and at a time when something in a curative way can be accomplished.

Dr. A. O. Singleton, Galveston, Texas (closing): I will admit that I am an amateur and, so far as I know, there are no experts upon this particular condition. The Boston Children's Hospital has had the greatest experience; they report some 31 patients operated upon, with a mortality of 100 per cent. I am of the opinion that it is hard to construct an artificial esophagus and make it work. I have tried some of them and did not succeed. To subject a child to a cervical fistula until you get the esophagus fixed is serious. The only way you can be sure you can do an anastomosis is by transpleural approach. One can still, if necessary, do a cervical esophagostomy in addition to closing the fistula.

Doctor Blalock's method, from the standpoint of saving life, may be a little safer, but the final outcome is not settled. One has a cervical fistula left and must depend upon making an esophagus at a later time, which is still a difficult undertaking.

CHRONIC CYSTIC MASTITIS: WITH PARTICULAR REFERENCE TO CLASSIFICATION*

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ALTHOUGH there is fairly complete agreement that chronic cystic mastitis is not an inflammation of pyogenic origin, yet the actual pathogenesis of the disease is poorly understood. However, in view of clinical and experimental observations with various sex hormones during the past several years, it appears that the disease may be related to an insufficiency or an excess of certain hormones, thereby suggesting that the disease is of endocrine origin.

CLASSIFICATION

There is, likewise, no agreement as to a method of classification of the various types of the disease, although various authors have suggested certain ways of classifying the various lesions encountered. We wish to make a strong plea for a classification which would be of clinical as well as pathological significance. The importance of this dual consideration is emphasized by the fact that certain types of chronic cystic mastitis may develop malignant characteristics. The experiments of Loeb,[1] Lacassagne,[2] and others, proving the development of carcinoma in the mammary glands of animals following administration of certain hormones, actually suggest the relationship of hormone imbalance to the development of carcinoma. However, since the amount of hormone required to produce carcinoma in their experiments was quite large, we cannot assume with any degree of certainty that such a relationship would exist in the human being.

We wish to present a classification of the various types of lesions, which is based chiefly on two factors: (1) The predominance of the pathologic lesion present; and (2) the relative danger of transformation to carcinoma. This classification includes four major groups as listed below:

Group 1. Adenofibrosis.—The essential lesion is a fibrosis which is relatively diffuse throughout the breast.

Group 2. Benign Parenchymatous Hyperplasia.—There is a proliferation of the glands and ducts, but no changes resembling malignancy or malignant tendencies. Secretory products accumulate in the dilated ducts.

Group 3. Precancerous Hyperplasia.—There is an advanced proliferation of cells (chiefly of the ducts), which reveal plication, layering, and increase in mitoses. The shape of the cells is atypical and variable. Many nuclei are hyperchromatic. There is a distinct resemblance to a malignant process although actual invasion is not seen.

* Read before the Southern Surgical Association, December 7–9, 1943, New Orleans, La.

Group 4. Cystic Disease.—Cysts are the predominant lesion although occasionally a large one (of the blue dome variety) may be found. There are usually several cysts. No epithelial hyperplasia is encountered.

TABLE I

RELATIVE INCIDENCE OF THE LESIONS ENCOUNTERED IN 76 SUCCESSIVE CASES OF CHRONIC CYSTIC MASTITIS OBSERVED AT ILLINOIS RESEARCH HOSPITAL

	Incidence	Average Age of Patients
Adenofibrosis	22%	37.4 years
Parenchymatous hyperplasia	46%	43.7 years
Precancerous hyperplasia	22%	41.6 years
Cystic disease	10%	46.4 years

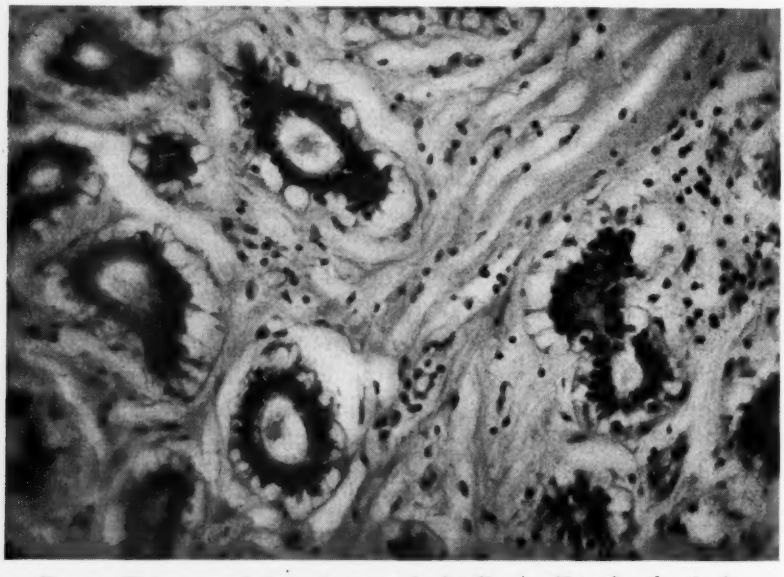

FIG. 1.—High power of the early stage of adenofibrosis. Note that the glands are relatively normal, but edema of the interstitial tissue is present along with deposition of histiocytes and young connective tissue cells. Later, the edematous tissue will be replaced with adult connective tissue with "smothering" of the glands as in Fig. 2.

We wish to emphasize that only on rare occasions will the lesion consist entirely of one of the four types described above. Occasionally, cases are encountered in which all four types of lesions may be found. However, with few exceptions, one of the lesions will be found to predominate. Since there is frequent blending of the various lesions, an accurate mathematical division will not be possible. The figures presented above, representing 76 cases of chronic cystic mastitis operated upon at Illinois Research and Educational Hospital during the past seven years, may be different from those encountered in a private hospital, because our hospital is a charity institution in which perhaps a more advanced stage of certain disease processes will be encountered. This might account for the relatively high incidence of precancerous lesions. We wish to emphasize very emphatically that the lesion which we have designated as precancerous is not necessarily going to terminate in carcinoma. There is no invasion; we, therefore, wish to emphasize that it

is still a benign lesion, which does not require radical treatment; however, simple mastectomy as discussed later is usually indicated so that all of the dangerous areas are removed. We have estimated that *if lesions were untreated,* the possibility of development of cancer in each of the four groups would be somewhat as follows:

Adenofibrosis	0%
Benign parenchymatous hyperplasia	3 to 10%
Precancerous hyperplasia	20 to 30%
Cystic disease	2 to 4%

Obviously, there is no way of determining the probability of development of carcinoma *since surgeons remove all the lesions which are of the suspicious type. Removal of the lesion eliminates the possibility of carcinoma unless the excision is inadequate.* As a matter of fact, we have observed development of carcinoma in precancerous hyperplasia treated by inadequate local excision. It should be emphasized that proper excision will reduce the possibility of malignant transformation to a minimal figure, but will preclude accurate estimation of the dangers associated with the respective lesions.

Semb[3] has classified chronic cystic mastitis into two groups: (1) Fibro-adenomatosis simplex (microcystica); and (2) fibro-adenomatosis cystica (with macroscopic cysts). He indicates that carcinoma may develop in such lesions, and remarks that in his series the frequency was 2 per cent in the former group and 24 per cent in the latter group.

PATHOLOGY

The four groups of lesions described below represent the four major pathologic changes observed in chronic cystic mastitis. Although more than one type of lesion is frequently encountered in the same breast, with few exceptions one of the four predominates.

1. *Adenofibrosis.*—In these lesions replacement of the breast by connective tissue forms the salient feature. The connective tissue appears to be laid down to replace a periglandular edema, seen best in the earlier cases. By proliferation the connective tissue comes to surround the glands and infiltrate between them. This process results in a fibrous stroma which breaks up the normal lobule arrangement and converts the breast to a markedly fibrous structure. We do not know the pathogenesis of this lesion. We do know that only a part or all of the breast may be so altered. We, likewise, know that it may occur at any age, and thus it is possibly due to several sets of factors which could excite the connective tissue elements to overgrow the epithelial.

In the early stages, the breast presents a tense, moderately increased consistence upon *palpation.* The parenchyma feels indurated and rubbery firm. The superficial surface may be somewhat granular because of minute nodules. This is produced by infiltration of the ends of Cooper's ligaments by the connective tissue (Cheatle and Cutler[4]). True nodularity as generally considered in breast lesions is produced by cysts, and these do not form a prominent feature in typical adenofibrosis, hence will not be a common finding. In

the later phases the breast palpates as a solid mass, uniformly of firm rubbery consistence.

The *gross pathologic* findings upon sectioning through such a breast consist of a generalized increase in parenchyma which is characteristically ivory-white in color. The apparently increased parenchyma is a relative feature, as it is more a feature of prominence rather than amount since most cases of adenofibrosis occur in rather small breasts. Firm, elastic, ivory-white tissue may be found to replace parts or all of the breast according to

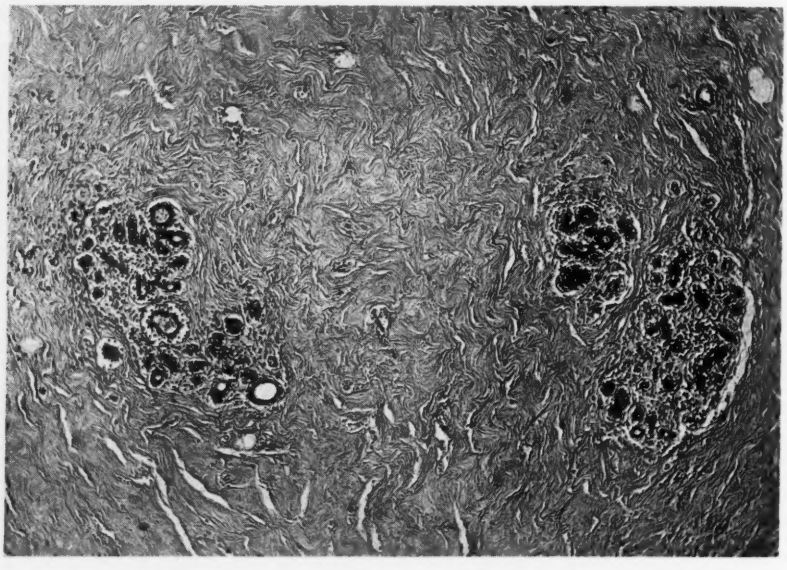

FIG. 2.—Advanced stage of adenofibrosis, illustrating a marked preponderance of fibrous tissue with a paucity of glands, the cells of many of which are showing degenerative changes.

varying involvement. Permeation into the marginal ligaments may produce a false lobulation of the superficial fat. At times the cut surface will reveal minute gray-pink specks. These represent areas of glandular hyperplasia, and are usually obliterated by the overgrowth of connective tissue. Cystic spaces are uncommon findings, and usually do not attain significance in either size or numbers in typical cases of adenofibrosis. Occasionally small cysts of a few millimeters size are encountered, however. These occur as sharply outlined spaces (actually only a simple dilatation of ducts), and contain a small amount of clear to pale cream-colored fluid. The presence of numbers of cystic spaces which may also range upwards to several centimeters in size throughout a fibrotic breast is indicative of a transitional state with one of the other types of chronic cystic mastitis.

The *microscopic* picture in adenofibrosis depends partly upon the duration of the process. Except for the long-standing cases, especially in elderly women, the usual case will demonstrate all the changes of the disease. The early changes consist of a moderate increase and proliferation of the glandular elements. The glands are grouped in lobular fashion, show moderate irregu-

larity of form with bud-like outbranching. The epithelium consists of two or three layers of small, dark, rounded cells. There may be slight dilatation of the ducts, chiefly due to a collection of bright reddish-colored secretory material, also present in the lumina of the glands. In many instances a zone of clear edema will be found about the lobule and likewise between and around the individual glands. Into this edema, fibroblasts and older connective tissue cells will be seen proliferating. In later phases this connective tissue proliferation and behavior becomes more and more prominent, forming the essential manifestation of adenofibrosis. Lobules are set apart by it; later the individual acini are separated from each other until no lobule arrangement can be distinguished. The end-result is one of widely separated glands and ducts lying in a very dense connective tissue stroma. In many such breasts large areas consisting wholly of connective tissue are found. Often, especially in senile women, only traces of atrophic glandular elements remain.

These are the findings of typical adenofibrosis; there should be no evidence of cyst formation or epithelial hyperplasia. When such changes are present as concomitant findings, it indicates that another type of chronic cystic mastitis has become superimposed upon adenofibrosis.

2. *Benign Parenchymatous Hyperplasia.*—As indicated by the term selected, this condition consists of a hyperplasia of both the glands and ductal elements of the breast. At the outset one must note that this is an epithelial proliferation, in contrast to adenofibrosis which is essentially an alteration of the breast by connective tissue changes. The manifestations of benign parenchymatous hyperplasia may be explained as the sequelae to an increased proliferation of the glandular elements followed by secretory activity. The secretory products are neither evacuated nor absorbed. They collect in the ducts, dilating them to form cysts. Stagnation and perhaps chemical alterations of this material allow it to act as an irritant upon the lining epithelium of the glands and ducts, thereby inducing a further irritative hyperplasia in their epithelia. This irritation theory, as held by Cheatle and Cutler,[4] Ewing,[5] and others, is very probably a factor of importance, but is probably a secondary one. The initiating factor for the preliminary glandular hyperplasia is probably a hormonal change, possibly an increase in estrogens.

The most significant *gross findings* in benign parenchymatous hyperplasia are the nodules present upon palpation. The nodularity is due to the presence of cysts, and dilated cord-like ducts. The stromal consistence is only moderately increased, and does not form such a significant feature as in adenofibrosis.

In the early stages *palpation* of the breasts reveals localized or diffuse areas of increased consistence in which are minute shot-like areas. Thin breasts, lacking any appreciable fat pad, may allow one to distinguish a number of swollen cord-like ducts which radiate away from the subareolar region. These ducts may reveal bead-like enlargements along their course. The later phases present a more generalized and distinguishable nodularity. The nodules are usually enlarged, ranging up to two centimeters in size and are thus more readily made out. They have a firm but resilient con-

sistence. Their multiplicity and only partial fixation are important features in differentiating them, since fibro-adenomas are usually freely movable, while carcinoma is significantly fixed as well as harder in consistence.

The *cut surface* in benign parenchymatous hyperplasia presents variable yet significant numbers of cystic spaces throughout a pale gray or light tan-colored stroma. In a strict sense these are not true cysts, but the sectioned

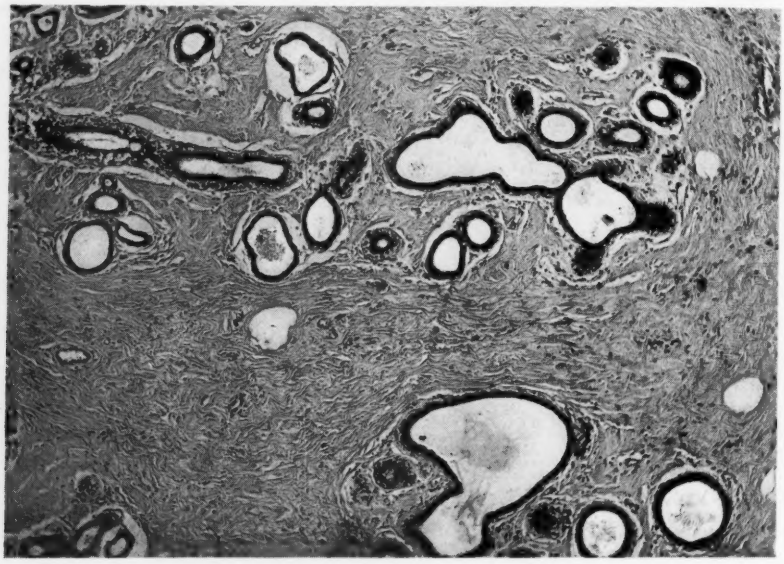

FIG. 3.—Benign parenchymatous hyperplasia, revealing an increase in number of the ducts with dilatation and an increase in the number of the cells lining some of the ducts. The interstitial connective tissue is unusually dense here, but will be moderately increased in almost all cases of chronic cystic mastitis.

lumina of dilated ducts. They are called cysts due to their general rounded outline, discrete character, and fairly distinct wall. When exposed, but before incision, they may appear as silver-blue to red-brown rounded masses. These features are due to retained material shining through thin duct walls. Incision of the cysts yields inspissated material which may show a wide range of character, from cloudy grayish-tan fluid to deep yellowish-brown material of buttery consistence. Removal of this material should reveal a smooth gray-white lining, a significant feature since absence of any epithelial alteration of the cyst lining (such as papillations) denotes the benign character of the lesions.

The stroma of parenchymatous hyperplasia is neither as abundant nor as firm in consistence as that of adenofibrosis, in which condition it forms the prominent feature. Cystic spaces, which are relatively uncommon and insignificant when present in adenofibrosis, form the basic picture in benign parenchymatous hyperplasia. One variation of benign parenchymatous hyperplasia should be noted. In some cases, the cut surface of the breast will present numbers of minute gray-pink specks, denoting foci of glandular hyperplasia.

Such areas are not a very prominent gross finding, but are, however, commonly found in the microscopic sections. For this reason a specific term *adenosis,* referring to alterations of glands, has been selected to identify such lesions. Microscopic examination may reveal a few areas composed of lobular or diffuse proliferations of glandular elements in contrast to the ductal alterations more commonly found. Since other sections from the same breast will generally show parenchymatous hyperplasia, it was felt that adenosis should be recognized, but relegated to a subgroup of parenchymatous hyperplasia.

The benign character of parenchymatous hyperplasia may be established on the basis of two gross findings. These are (1) the absence of gross papillations of the epithelial linings of the enlarged ducts and cysts after evacuation of their contents; and (2) a uniform, moderate consistence, showing no irregular firm to hard areas. Breasts presenting either of these findings should be considered in an advanced state of epithelial hyperplasia and should be examined carefully by histologic examination for the presence of precancerous or malignant changes.

Microscopically, benign epithelial alterations in the lining epithelium of glands and ducts form the most significant finding. In most instances the changes are most prominent in the ducts, the glands being altered but to a lesser degree. A second prominent feature of benign parenchymatous hyperplasia is the presence of glands and ducts dilated to cystic proportions, and filled with secretory products and epithelial débris. The epithelial changes consist of a moderate increase in the size of the cells, which assume a polyhedral outline. Their cytoplasm is more prominent and the nuclei become darker staining. The cells often appear in several layers, and show a tendency to form pseudopapillary processes with no supporting stroma. The picture is one of overgrowth, but cannot be considered neoplastic in type. The benign character is indicated by the uniform size and shape of the cells, even staining qualities, a regular pattern or stratification of the piled-up cells, and lack of bizarre mitoses. There is no tendency towards invasion of the surrounding stroma.

While the changes described above are usually most prominent in the ducts, there may be a sufficient preponderance of glandular hyperplasia (*i.e.*, increase in number of glands) and alteration as to warrant designation of the subgroup *adenosis.* In this type of lesion, glands, which are increased in number, are arranged in lobular patterns, or as a diffuse proliferation. The glands are composed of darkly-staining epithelial cells, which, likewise, may be several layers deep. There are no other significant changes beyond those described in the ducts, and the hyperplasia is well within benign limits. The glands in adenosis frequently contain a reddish secretory material in their lumina.

Accompanying these epithelial alterations of glands and ducts are the cystic changes. Reddish-staining secretory material is seen in many of the glands and as this collects in the ducts, cysts are formed by dilatation. The dilated cystic ducts are lined by flattened epithelium. In the cyst lumina

the secretory material is often found to contain desquamated cells and their débris.

These are the essential findings of benign parenchymatous hyperplasia. The mild degree of epithelial hyperplasia as described is benign in nature. It is important to note that we are dealing with *epithelial changes* and that as such we must remember they may be transformed to or be accompanied by more advanced epithelial changes, which could alter the findings to one of precancerous hyperplasia or actual carcinoma. Again, benign parenchymatous hyperplasia may accompany or become superimposed upon the changes of adenofibrosis.

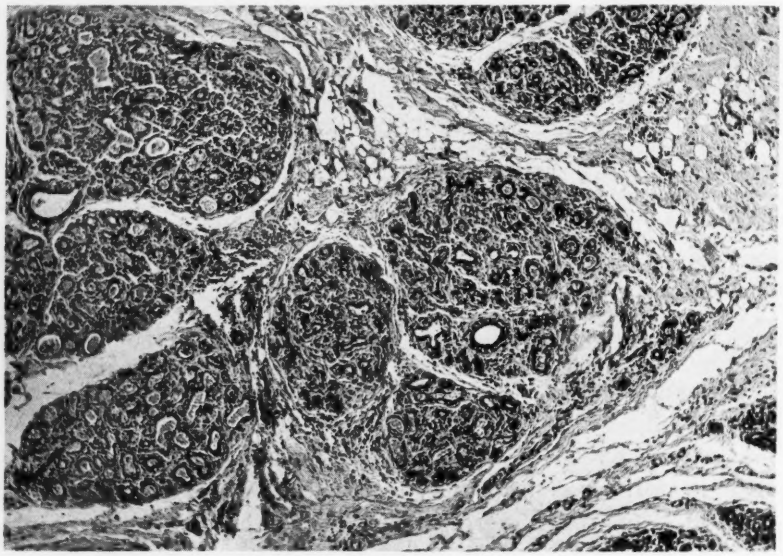

FIG. 4.—Benign parenchymatous hyperplasia, revealing marked increase in glandular elements, presenting a picture which we have designated as adenosis.

3. *Precancerous Hyperplasia.*—By definition, this group consists of those cases having an epithelial hyperplasia which resembles that seen in carcinoma. The hyperplasia exceeds the benign limits characterizing parenchymatous hyperplasia, yet lacks the invasiveness and anaplasia of cancer. This is a controversial group clinically speaking, inasmuch as it is impossible to tell which of these cases will go on to actual malignancy. The authors have seen this lesion in close proximity to unquestioned cancer, and have seen cancer develop in breasts known to harbor such changes through biopsy at some previous time. Also, we have found microscopic fields in these lesions which lacked only the criteria of invasiveness to be called cancer. Such areas cannot be ignored under a simple benign diagnosis—the welfare of the patient and surgical conscience demand a more precise terminology. The existence of lesions bearing a potentiality for malignancy is in the authors' opinion an adequate reason for separating them in a definite group. We wish to describe these lesions pathologically, discuss their pathologic possibilities, and thereby offer a basis upon which therapy may be prescribed.

First, we wish to emphasize the unfortunate fact that *there are no criteria by which this group may be identified or separated from parenchymatous hyperplasia except microscopically.* Neither palpation nor examination of the cut surface yields distinctive diagnostic findings. Conclusions drawn from such examinations should be considered presumptive only, and chiefly for the purpose of selecting areas for thorough histologic study. Nearly all such cases will present features resembling those of benign parenchymatous hyperplasia (which is frequently concomitant), and the gross pathologic problem resolves itself into the selection of areas for microscopic study.

There are a number of *features which will aid in the selection of tissue blocks* to find the most hyperplastic and suspicious areas. These are: (1) The lining epithelium of ducts is usually smooth, glistening, and silvery-pink in color. Any discolored, roughened, thickened, or pebbled areas should be regarded with suspicion and removed for section. Sometimes in the larger collecting ducts one may find low papillations, or even discover an intraductal papilloma. These structures should therefore be examined carefully. (2) The cross-sectioned lumina of ducts and cystic spaces will be filled with secretory débris. Upon moderate pressure this material can be evacuated, leaving a fairly smooth inner wall. Spaces which yield only a central core of their contents while a dirty gray-tan débris remains should be regarded with care. (3) Areas which appear to be a coalescence of minute cystic spaces with ill-defined walls and but little excrescent débris are especially suspicious. (4) Here and there areas of a firm indurated character are often palpable, but not readily visualized. These likewise should be examined microscopically, frequently necessitating a number of tissue blocks. The authors have found that search for these areas is greatly facilitated by a definite technic. If after a preliminary examination by palpation and a cut section one is able to rule out cancer, further examination is deferred to fix the entire specimen in formalin. After fixation, the specimen is washed, and then examined by making parallel cut-sections through the entire specimen. These should be about one centimeter apart, so that the resultant slices may be palpated from both sides. Much information may be gained by such a method since very small areas of increased firmness will be discovered when palpated from both sides between thumb and forefinger. The value of this technic is apparent when one emphasizes that the entire problem in these lesions is a microscopic one. Since the gross findings are very inconclusive, the microscopic problem can only be solved by an adequate search for the evidence of precancerous hyperplasia by numerous tissue blocks. Naturally most of the areas removed will show benign parenchymatous hyperplasia. *Only one part of the breast, perhaps only a single block,* may show a precancerous change. When a precancerous change is found, it becomes the essential feature in diagnosis, regardless of the benign character of the remaining breast.

Since the microscopic problem is an extremely important one, good microscopic sections as well as pathologic familiarity with these lesions are necessary for an accurate diagnosis. The authors do not believe that a frozen section

reveals the microscopic changes found in these lesions in a manner which will allow an honest interpretation. We have seen a number of errors in the conclusions drawn from frozen sections. It is difficult enough to make an accurate interpretation on excellent sections. Since this problem is so important to the patient's future welfare, we feel that only excellent microscopic sections should be used in identifying these cases.

The *microscopic diagnosis* of precancerous hyperplasia is built upon a combination of findings which indicate advanced epithelial alterations beyond

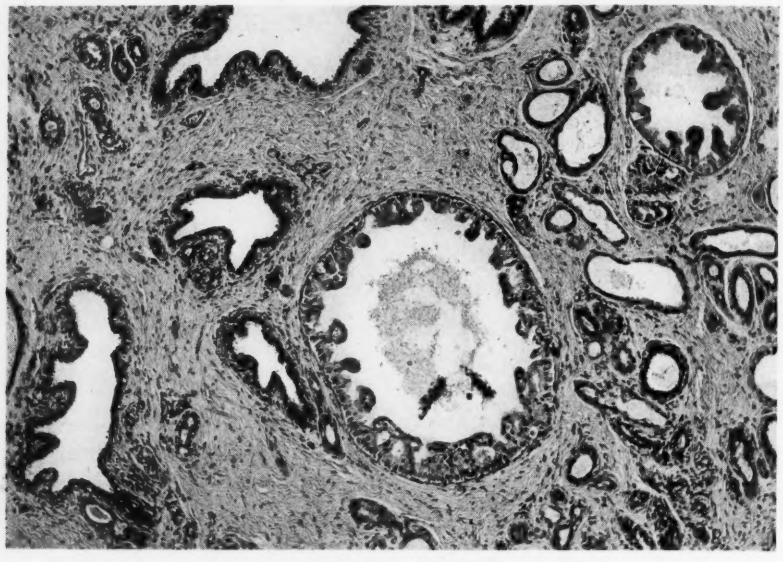

FIG. 5.—Precancerous hyperplasia, revealing papillations and layering of cells lining the ducts, many of which are dilated.

those seen in parenchymatous hyperplasia and approaching the epithelial changes of cancer. Since all cancers of this organ are not alike, neither will the precancerous alterations be similar. Thus one may encounter various types and degrees of epithelial overgrowth.

In most cases there will be a generalized gland and duct hyperplasia as seen in benign parenchymatous hyperplasia. The features manifested in precancerous hyperplasia begin as an increased number of the cells lining ducts and glands, *chiefly the former.* Plication, pseudo or actual papillary processes are found associated with these multilayered epithelia. Gland and duct outlines become distorted and some become filled with the overgrowth of their lining cells. Somewhat more advanced stages may show well defined microscopic cystadenomas and papillary adenomas. Ducts are found plugged with swollen epithelial cells. There are alterations of form and arrangement, size and numbers of glands and ducts, and their cellular components, but of themselves these changes are not necessarily precancerous. If in addition one finds alterations of the cells, consisting of increased and variable size, irregular staining features, along with swollen, vacuolar and hyperchromatic

nuclei which display increased mitoses, we are justified in terming the lesion precancerous. Cell polarity is indicated by the pattern of the cells in relation to their underlying wall or the stromal core of a papillary process. When the cells range side by side in an even, regular pattern with their long axes parallel, the lesion is not advanced. Conversely, if there is heterogeneous grouping of cells with no attempt to form a pattern, such as when cell axes are lost or point in all directions, then one is dealing with a more advanced lesion. While the resemblance to cancer is at times remarkable, we do not feel justified in a diagnosis of cancer without the criterion of actual invasion. We believe that these features of cellular overgrowth in its various forms (plication, papillations, and filling of lumina), along with variable polarity and cellular changes approaching anaplasia, are all features which resemble those seen in cancer, but do not constitute cancer without cellular infiltration of the breast stroma. We do feel that hyperplasia of the precancerous type as described should be classified as a separate entity, particularly since treatment is different from that of other types of chronic cystic mastitis.

4. *Cystic Disease (Involution Cysts).*—This condition may be defined as a solitary-appearing cystic mass of the breast, usually found in elderly women. The appearance of the cysts during the menopause or immediately following has led to the conclusion that their origin is in some manner sequel to the involutionary changes of the breast, and the concomitant endocrine alterations of this period. There is no evidence of any neoplastic or inflammatory relationships. There are no epithelial changes which would point to any relationship to cancer, hence they are essentially benign in nature. Frequently they arise on the anterior surface or lateral margins of the breast, in which position part of the cyst may be raised above the breast surface, the remainder being implanted in the breast parenchyma.

Gross pathologic examination of the excised specimen reveals a discrete, rounded, fairly movable mass which is palpably tense, but not definitely hard. The mass, containing fluid under pressure, will not fluctuate, but yields elastically in some instances. They are usually more resilient than the average fibro-adenoma. Usually a single cyst, ranging from three to six centimeters in size, is found, although several smaller satellite cysts may be grouped around the base of a larger dominant cyst; on other occasions small cysts may be matted together and to palpation give the impression of a single mass. Upon exposure, some of the cysts will present the typical "blue dome" of Bloodgood. All will not present such an appearance, since some are thick walled or deeply embedded in the breast substance. Incision into the cyst allows a serous or semicloudy fluid to escape, usually spurting from pressure. Cysts containing serous fluid will generally show a smooth silvery-white interior lining, whereas those having cloudy fluid present a dull, light gray lining which resembles granulation tissue. The smooth, unaltered lining of the cysts characterize the condition as benign. No papillary processes or other epithelial changes of the lining are present, therefore little relation to cancer exists. The cyst "walls" are composed of gray-white tissue, actually the sur-

rounding breast parenchyma which has been compressed by the expansion of the cyst. They have a leathery consistence which cuts with considerable resistance. The thin walls of the "blue dome" variety allow their contents to shine through, thus yielding the characteristic appearance. They are found often near the surface, the small amount of overlying parenchyma being thinned and compressed as the cyst expands upward. The remaining breast may show any of the other varieties of chronic cystic mastitis which could be present before cystic disease developed. However, most cases show only the soft fibro-fatty tissue of the involuted breast.

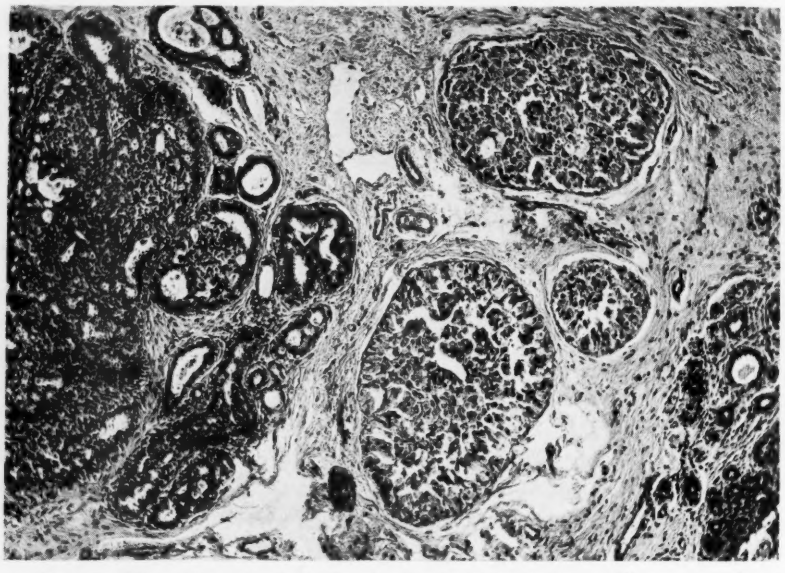

FIG. 6.—More advanced stage of precancerous hyperplasia, revealing a growth of lining cells sufficient to fill the ducts. However, there is still no invasion suggestive of malignancy, although the cells of the ducts as well as glands are irregular in size and shape and stain deeply. Mitoses are common.

Microscopically, the cyst wall is found to have a rather fibrous stroma containing flattened and compressed parenchyma; the lining epithelium is usually shrunken and pale, and atrophic in appearance. The serous type of cyst is found to have a single layer of flattened cells forming its lining. The cysts having a cloudy fluid content show a few layers of similar small cuboidal type cells which are loosely held together and appear desquamative. These are sometimes infiltrated with a few lymphocytes. Degeneration and desquamation of these cells would account for the cloudy fluid in the cysts. These minimal epithelial alterations signify the benign nature of the cystic structures termed cystic disease.

RELATIONSHIP OF CHRONIC CYSTIC MASTITIS TO CARCINOMA

Years ago there was by no means complete agreement that chronic cystic mastitis would develop malignant characteristics. However, practically all of the investigators reporting on the disease during the past few years have concluded that carcinoma may and does arise in chronic cystic mastitis.

One of the most convincing of these studies is that reported recently by Warren.[6] He studied the incidence of cancer of the breast in the State of Massachusetts as compared with another series from Toronto. After this study he concluded that "the breast cancer attack rate for women with chronic cystic mastitis and related lesions in the age-group from 30 to 49 years is 11.7 times the rate for the Massachusetts female population; in the group over 50 years of age, 2.5 times as great; in another group, 4.5 times as great." Cheatle and Cutler[4] have estimated that at least 20 per cent of their cases of cancer arose in areas of chronic cystic mastitis. The authors are likewise convinced that carcinoma of the breast frequently arises in areas of chronic cystic mastitis. Since we have observed carcinoma develop in areas of precancerous hyperplasia, and have encountered this type of lesion in 15 or 20 per cent of our cases of carcinoma of the breast, we are convinced that there is a definite relationship between carcinoma and chronic cystic mastitis, particularly the type which we have described as precancerous hyperplasia. As previously discussed, it is impossible to estimate, with any degree of accuracy, what percentage of cases of chronic cystic mastitis might develop carcinoma, since suspicious lesions of the persistent type are removed surgically.

CLINICAL MANIFESTATIONS

There are relatively few manifestations of chronic cystic mastitis. Differentiation of the various types cannot be made on symptoms alone because of the extreme variability of complaints. As discussed below, examination will help to a great extent. Pain is the most constant complaint, but it is extremely variable in intensity. It is by no means present in all cases. It is usually increased during menstruation, and rarely severe. In patients complaining of severe pain, findings are apt to be minimal; in fact such cases are usually best classified as mastodynia, which is probably not related to chronic cystic mastitis. In these cases, examination is usually negative.

In about 5 per cent of cases discharge from the nipple will be noted. In about half of these (Hinchey[7]) the discharge will be bloody.

Examination usually reveals a slight enlargement of the affected breast. The breast tissue itself is not attached to the skin. Tenderness is fairly constant, and is usually more pronounced over the nodules, but the location may change from day to day.

In *adenofibrosis* the whole breast is apt to be involved in the disease process. The parenchyma is indurated rather diffusely and has an elastic resiliency. The surface of this disk-shaped breast tissue is roughened but not very nodular. In this group tenderness as well as pain is usually mild.

In *benign parenchymatous hyperplasia* the indurated areas are apt to be local and possess nodular characteristics. These nodules vary from 0.5 to two centimeters in diameter and are usually cysts containing fluid under a variable amount of pressure. The stroma itself is less firm than in adenofibrosis. Tenderness and pain are variable, on some occasions being quite prominent.

In *precancerous hyperplasia* the history and examination will be very similar indeed to parenchymatous hyperplasia. Only on cut section of the excised tissue can an impression be gained as to the seriousness of the lesion. Even then impressions are usually inaccurate until the microscopic section can be seen.

In *cystic disease* the breast itself is usually atrophic, particularly since most of these patients are in the older age group, past the menopause. Large nodules up to four or five centimeters in diameter may be palpable.

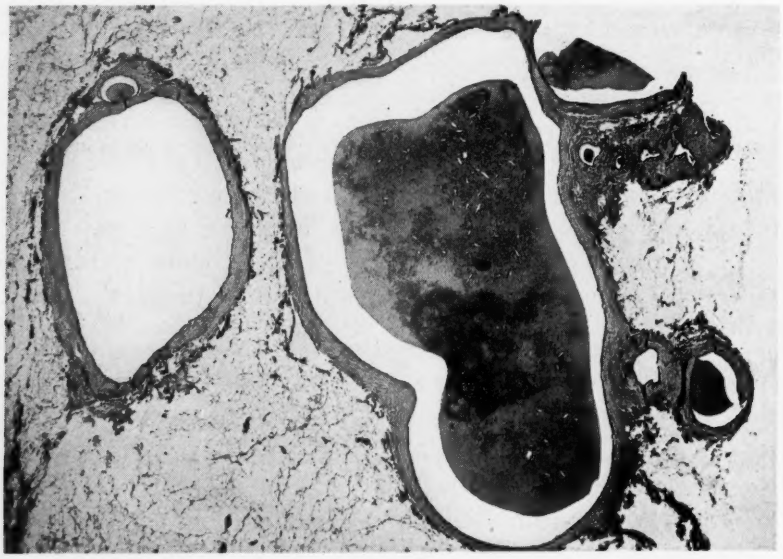

FIG. 7.—Cystic disease, revealing cystic spaces (dilated ducts?) with no cellular hyperplasia and a relatively slight increase in connective tissue elements.

These nodules, which are of course cysts, may be palpated as resilient non-fluctuant areas. Many of the cysts are of the type described by Bloodgood as "blue dome" cysts. Frequently numerous small cysts are present and so matted together that the involved area is palpated as a solitary nodular mass; only on cut section may the true nature of the lesion be revealed.

Differential diagnosis may be extremely difficult. The lesion may simulate benign neoplasms, but fibro-adenomas are usually more circumscribed, and firmer in consistence. Likewise, there may be extreme difficulty in differentiating chronic cystic mastitis from early cancer. Although a diffuse nodularity implies the presence of chronic cystic mastitis, yet there is always a danger that a carcinoma may be developing in one of the nodules, unless the patient is quite young. One of the most reliable signs in aiding differentiation of chronic cystic mastitis from carcinoma is skin retraction, which is fairly constant in carcinoma, even of the early type. Rarely, indeed, is skin retraction present in chronic cystic mastitis, unless an acute inflammation has been present at some previous time. This difficulty of differentiation complicates treatment as will be discussed below, and frequently influences the physician toward operative therapy.

TREATMENT

A decision first must be made as to whether or not nonoperative or operative treatment is indicated. In general, conservative treatment in young women is safe and more strongly indicated than in women past the age of 45 because of the possibility of cancer in the latter group. In young women a nodular breast having no skin attachments or other characteristics of carcinoma can be treated safely, by the conservative methods, at least for a time. This treatment is particularly indicated when the lesion has been present only for a short time, because on many occasions the lesion will disappear spontaneously. As an example, we might briefly present the clinical picture and progress in a young woman 26 years of age, who had

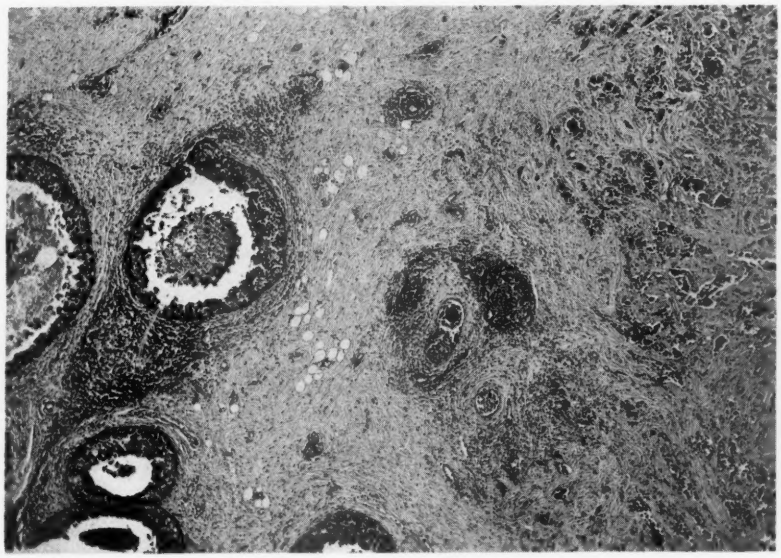

FIG. 8.—Precancerous hyperplasia (on the left) present alongside carcinoma (on the right). Eight months previously a small nodule revealing precancerous hyperplasia similar to that shown on the left was removed, but a mastectomy was not performed. A nodule recurred with obvious malignant characteristics, necessitating radical mastectomy.

been married two years without pregnancy. When first seen, she had in her left breast a tender mass, two centimeters in diameter, which was only of four weeks' duration. This nodular mass had the characteristics of chronic cystic mastitis, but under observation disappeared spontaneously within three months.

Adequate support of the breast is indicated for the relief of pain. Heat therapy may be helpful. It is well known that pregnancy and lactation cause chronic cystic mastitis to regress.

All sorts of hormone therapy have been advised and used in chronic cystic mastitis. However, the authors have had the same experience as Taylor,[8] who reports that he has not seen any favorable effects from hormone therapy.

As intimated previously, the clinician may be unwilling to delay operative treatment in a patient in the cancer age with chronic cystic mastitis over

an indefinite period, particularly if one of the nodules is more indurated and less defined than the others. In women past 40 or 45 there is a tendency to resort to local excision, particularly if the mass has been there more than a few months. Attempt should be made to remove all of the nodules. This may require resection of half the breast. Regardless of the amount of breast involved, considerable normal tissue adjacent to the nodules must be removed so that all the diseased area is included in the resected tissue. If a wedge-shaped sector is removed, the cut edges can be approximated, thereby eliminating dead space. It is essential to eliminate dead space, since infection is apt to develop in these areas. Hemostasis must be carefully achieved; spontaneous cessation of bleeding occurs slowly on the cut surface of breast tissue, because the firm breast tissue does not allow retraction and contraction of the cut vessel. A drain may be inserted for 12 or 24 hours, but should not be allowed to remain longer than that time. Under ordinary circumstances the wound is closed without drainage.

As stated previously, it may be impossible to identify precancerous areas by clinical means in the mastitis lesions. We are firmly convinced that if the microscopic section reveals precancerous tissue, as illustrated in Figure 5, or 6, a complete mastectomy (not radical) should be performed. We have observed carcinoma develop in a breast following inadequate removal of precancerous tissue. Moreover, it is now estimated by most authorities, including Cheatle and Cutler,[4] and others, that at least 20 per cent of the carcinomas of the breast develop in, or pass through, a stage of chronic cystic mastitis. Ewing[5] has stated that "about 50 per cent of the breasts excised for cystic disease show pronounced precancerous changes or miniature carcinomas." We are, therefore, firmly convinced that when local excision reveals hyperplasia of the precancerous type, the entire breast should be removed.

SUMMARY

In view of the marked confusion as to the classification of the various types of chronic cystic mastitis, we have attempted to separate the lesions into groups which would have a pathologic as well as clinical significance. From this standpoint, it appears to us that chronic cystic mastitis can be divided into four groups as follows: (1) Adenofibrosis; (2) benign parenchymatous hyperplasia; (3) precancerous hyperplasia; and (4) cystic disease. At times a single specimen may reveal gradations of all four types described, but with few exceptions, one of them predominates. A lesion is classified as precancerous even if only a very small portion of the breast reveals this type of change. The types of pathologic changes herein described have been recognized and described previously, but we have endeavored to formulate a classification which would avoid complicated terms and yet have a pathologic as well as clinical significance.

Our classification is based somewhat upon the supposition that carcinoma may at times be superimposed on chronic cystic mastitis. We are convinced, as are practically all workers publishing material on the subject during the past few years, that carcinoma can and does develop in certain types of

chronic cystic mastitis. In our estimation and experience, carcinoma is most apt to develop in precancerous hyperplasia, which is in itself a benign disease. In view of the strong possibility of development of carcinoma in precancerous hyperplasia, we recommend simple mastectomy (not radical) if removal of a nodule reveals a hyperplasia of the precancerous type. Adenofibrosis and cystic disease are least susceptible to malignant change, and fortunately are readily distinguishable clinically and pathologically (particularly from the pathologic standpoint) from parenchymatous hyperplasia and precancerous hyperplasia.

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DISCUSSION: DR. J. GARLAND SHERRILL, Louisville, Ky.: The report of Doctor Cole is excellent and I appreciate it very much. Many of the best surgeons think it wise to obtain a biopsy in doubtful cases; however, in my opinion there is the possibility that one may be misled if the section is taken from a portion of the growth in which malignant change is not yet present, whereas in another part the evidence would be clear-cut. Then, too, there is the possibility of spreading the disease if the proliferating cells are transported as a result of the section.

We have usually attempted to make a diagnosis from the clinical history and physical examination. On this account "when in doubt it is well to play trumps." One rarely makes an error if the symptoms point strongly to cancer, and we have had no regret because of early and radical removal of a suspicious neoplasm. When in doubt it is wise to remove it at once, radically, and if considered wise, to follow this by irradiation. Two cases have impressed me as to the greater activity of cancer in young women. The first was in an unmarried woman, age 24, who consulted her physician four days after she first noticed a rounded growth in her breast, with no palpable nodes in the axilla or other evidence of a lesion elsewhere. She came to radical removal with complete dissection of the axilla, also had irradiation, yet died within the year. In another case, a woman in the early 30's presented a suspicious erosion on the cervix with irregular bleeding. The extent was so slight that some doubt of cancer was expressed. A most radical removal was promptly performed but without avail.

For this reason I am certainly very radical in treatment in young patients. On the other hand I have seen an old man live for many years with a skin epithelioma, with but little treatment, and finally die of an intercurrent affection, with little disturbance from the malignant growth. In my experience growths out from the body are less dangerous than those which tend to extend into the tissues.

DR. J. SHELTON HORSLEY, Richmond, Va.: Doctor Cole has given one of the best expositions of chronic cystic mastitis that I have heard. I should like to ask him if he has observed any connection between the administration of estrin products and the occurrence of chronic cystic mastitis or cancer.

DR. JOHN C. HENTHORNE, Vicksburg, Miss.: I agree with Doctor Cole that there seems to be a recent increase in the belief that certain forms of cystic mastitis are premalignant. On the other hand, this belief may prove to be more a matter of religion than science and may be a step in the wrong direction. The pioneer work on cystic mastitis as a benign disease not related to cancer was done by Bloodgood,* who found that the incidence of cancer was somewhat less in patients who had chronic cystic mastitis than it was in the general population. Campbell,† whose work was called to my attention by Doctor Bell at the University of Minnesota, came to the same conclusions as Bloodgood.

One of the slides shown by Doctor Cole demonstrated the peculiar type of eosinophilic epithelial hyperplasia sometimes called Schimmelbusch's hyperplasia. For many pathologists this type of hyperplasia is a landmark of benignancy in questionable lesions of the breast. In another slide, the last, there was demonstrated a comedocarcinoma. In this type of carcinoma the cystic cavities are not related to cystic mastitis, but are caused by necrosis of the cancer epithelium in the centers of cell masses and, therefore, this slide in my opinion does not demonstrate any relationship between cystic mastitis and cancer.

Doctor Ewing once pointed out that occasionally pathologists become interested in certain forms of cellular hyperplasia and want to call them malignant because of bizarre morphology. Ewing suggested that in order to establish the malignancy of hyperplasias of this type it was necessary to follow a number of patients who had this type of disease long enough to demonstrate that some of them develop metastasis or other well known phenomena characteristic of malignant tumors.

It seems to me that religious adherence to schools of thought based upon the morphology of chronic cystic mastitis may lead us in the wrong direction. If clinical observations as suggested by Ewing are carried out, it seems likely that many of the types of cystic mastitis now thought to be precancerous will prove to be completely benign if the patients are followed as closely as Bloodgood followed his cases, some for a period of 25 years.

DR. WARREN H. COLE, Chicago, Ill. (closing): Doctor Sherrill is correct in his statement that if you cannot be sure about the diagnosis, and fear cancer, the breast should be removed or a very wide excision done. But the chief point in my presentation is to urge improvement in our diagnostic ability so that we will not have to remove every nodular breast we see. One can readily see how many mastectomies would be performed if we adopted the policy of removing all nodulous breasts, since perhaps the majority of women past the age of 40 have a variable amount of nodularity in their breasts.

Doctor Horsley's question is hard to answer. We had one patient develop carcinoma while under theelin therapy, but perhaps that patient would have developed carcinoma anyway. The experiments of Loeb and Lacassagne prove that in mice, carcinoma can be produced with estrin, but they used large doses. Anyway, if I were a woman I would not want to take estrin compounds over a long period of time. I am sufficiently fearful of the danger of production of carcinoma by estrin compounds that I do not believe we should prescribe them except for temporary use.

Doctor Henthorne called attention to the fact that Doctor Bloodgood did not believe carcinoma developed in chronic cystic mastitis. I might also add that Doctor Bloodgood, like anyone else, may at times have been in error. I believe I am quoting Geschickter (who was an associate of Bloodgood) correctly, when I say that he (Geschickter) now believes that carcinoma does develop in chronic cystic mastitis. The best clinical follow up report I know of on this subject is that of Shields-Warren, who has conducted extensive research into the possibilities of development of carcinoma in chronic cystic mastitis; he is convinced from his studies that these patients do develop carcinoma. The area of the section which Doctor Henthorne thought revealed comedo carcinoma, true enough resembles that lesion, but in reality shows degenerated epithelial debris in ducts which are the seat of advanced epithelial hyperplasia. If we did radical mastectomy for such lesions we would frequently be guilty of performing needless radical surgery for benign lesions.

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THE SURGICAL MANAGEMENT OF CRYPTORCHIDISM*

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THE FACT that some confusion still exists in regard to the management of the undescended testicle and the rather unsatisfactory end-results we have noted in some of the 110 cryptorchids that have come under our care has encouraged presentation of this subject. Our purpose will be to indicate that results generally could be improved by a more widespread adjustment of management to conform with certain significant and apparently unappreciated observations.

For several years attention has been focused on the response of the undescended testicle to endocrine stimulation. Rational evaluation of this form of therapy seems to have been delayed an unusual time in some quarters. That the method has a natural appeal is easy to understand. Its limitations and dangers have not, however, been fully realized. While time does not permit a comprehensive discussion of hormonal treatment and in spite of the fact that only a few definitely proven undesirable effects have been reported, our own observations, and those of many others, have convinced us that artificial stimulation of the retained testis by any gonadotropic or androgenic substance has a small field of usefulness—is practically unnecessary and may be harmful. We must remember that the intimate relationship of the testicle with the thyroid, pituitary, and adrenal is as yet poorly understood; and it is our belief that stimulation of the endocrine system has harmful potentialities and should be avoided, in that it may result in glandular imbalance or other systemic disturbances.

For purposes of discussion it is desirable to classify cryptorchids into three groups, *viz:* Group I: Endocrinopaths with retained testes. Group II: Those with ectopic testes. Group III: Those with inguinal canal or abdominal retention. Pseudocryptorchids and infants with spastic retraction require only recognition as such and no consideration from a treatment standpoint.

GROUP I—ENDOCRINOPATHS WITH UNILATERAL OR BILATERAL NONDESCENT

These boys must be carefully studied from an endocrine standpoint. Most of them present the familiar adiposogenital syndrome of Frölich, with hypogenitalism. For these, hormonal therapy is appropriate and frequently results in testicular descent. We must, however, remember that physiologic variation in pituitary function occurs, and may result in obese changes with questionable genital hypoplasia and with delayed descent of the testicle. We have seen adequate genital development proceed and descent occur in untreated boys of this type. It is highly probable that endocrinal treatment

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has been given undeserved credit for producing descent in many of such instances, especially if injections were begun shortly before or at the time of puberty. Boys in this group, whose testes fail to descend at puberty or who have testicular ectopy, will, of course, require surgical attention. As a whole, the group is a small one. In our series less than 3 per cent.

GROUP II—THOSE WITH ECTOPIC TESTES

This group is also small. The testicle is outside the path of normal embryologic descent. Surgical attention is necessary and may be instituted at any age, *i.e.*, whenever one is satisfied the testis is ectopic. Certainly one could not expect spontaneous descent to occur in any of this group. The futility of hormonal treatment is apparent. Indeed, there is considerable experimental evidence in support of definitely harmful results from its use. Mimpriss reports degenerative changes in the mechanically retained testes of rats treated by hormonal injections. Eisenstadt, Appel, and Frankel noted similar degenerative changes in the retained testicle of rats subjected to hormonal treatment and at the same time observed no influence on the normally placed gonad. It would seem, then, that for the ectopic testicle, hormonal injections are contraindicated and suitable surgical treatment should be undertaken at any convenient age.

GROUP III—THOSE WITH INGUINAL CANAL OR ABDOMINAL RETENTION

Approximately 90 per cent of cryptorchids fall into this group. The testis is found somewhere along the course of the inguinal canal or occupies a retroperitoneal abdominal position. We, and others, have observed natural spontaneous descent in some boys in this group and usually at the time of puberty when the testicle receives its normal endocrine stimulation. In view of this possibility, postponement of surgery until the advent of puberty or shortly thereafter seems not only rational but advisable, since in this way many surgical procedures will be made unnecessary. Wangensteen has shown that little growth occurs in the testis from birth to adolescence and he also noted little or no difference in the cellular structure of the retained and the normally placed testicle during that time. The significance of these observations deserves emphasis. It would seem then that because of the possibility of spontaneous descent in this group and in view of the fact that the testicle will not suffer degenerative changes by virtue of its undescended position and, further, because surgical accidental destruction will be minimized through fewer operations, observation until puberty or shortly thereafter should definitely improve our ultimate end-results.

The difficulties encountered during the surgical management of the undescended testicle are quite familiar to every surgeon. While normal size and position are highly desirable, this combination is all too often unattainable because of the maldeveloped or atrophic structure uncovered at the time of surgery. We have been impressed with the frequency of separation of the epididymis from the body of the testicle and other developmental defects of equal significance. In one of our patients, age 19, a cystic epididymis with

vas deferens attached was in the scrotum, while the testicle and vascular cord components were just outside the internal abdominal ring. This caused considerable diagnostic commotion because the cystic epididymis was of good size and felt like a testicle both to examiners and patient. Since the vas deferens joined the scrotal mass, his referring physician was certain the patient had three testes. In spite of anomalies, one must attempt low scrotal placement in all but the hopelessly atrophied in the interest of appearance, internal secretion and morale.

Of the numerous surgical methods devised and employed we are at present convinced that the Keetley-Torek procedure is best adapted. This technic is so well known that I shall not recite its description. Two or three points, however, merit attention. Scrotal-thigh anastomosis materially aids development of the scrotum, and prolonged thigh fixation of the testicle, by overcoming contractility in the elastic structures of the cord, prevents subsequent retraction to the top of the scrotum, where we have so often found it after other surgical methods.

Satisfactory cord lengthening is of course essential. Deliberate and painstaking care during this procedure cannot be overemphasized. In this connection we have found it quite helpful to liberate the vas deferens and cord vessels separately well inside the internal abdominal ring, and frequently follow them more than a finger's length in their retroperitoneal position. One is surprised at the amount of elongation obtainable in this way and very grateful in that intrafunicular dissection is minimized. The spermatic artery is often extremely small, difficult to recognize and easily injured. We seriously doubt that the testicle can be adequately nourished by the artery to the vas and believe that in most instances atrophy of the testis or failure to grow after orchiopexy is the direct result of imperfect surgical technic in cord handling. To avoid it one must exercise the greatest care during this procedure and be certain that fixation of the testicle to the fascia of the thigh is accomplished without undue tension.

From the standpoint of end-results insofar as low scrotal position is concerned our experience with the Keetley-Torek method has been highly satisfactory. If, at the time of surgery, the testicle can be brought to a sufficiently low level one may be assured it will retain that position when, after thigh fixation, it is replaced in the scrotum. In none of our patients has subsequent retraction to a high scrotal position occurred. On the other hand, in approximately 20 per cent the testis has remained smaller than its fellow. In about one-half of this number its original structure was maldeveloped, while in the remainder the circulation was probably injured at operation. We have employed vitalium prosthesis in two young men in whom unilateral postoperative degeneration occurred. In both of these instances the cosmetic result was satisfactory and we have been unable to detect any unfavorable local tissue reaction.

While the weight of evidence seems to favor a greater incidence of malignancy in the undescended testicle, we have not observed its occurrence

in any of our group, and feel that the possibility of development of malignancy should not encourage removal of the undescended testis, but does condemn intra-abdominal replacement. Orchidectomy should be reserved for testes presenting definite or suspicious malignant changes. Those with extreme degrees of atrophy may also be sacrificed to advantage.

The incidence of hernia varies in reported series from 75 to 90 per cent. We have found a hernial sac in all patients coming to operation, and have employed the Ferguson type of repair in order to avoid any loss in cord length. While the processus vaginalis in many instances is empty, one is usually able to demonstrate a small communication with the peritoneal cavity.

Many investigations have convincingly shown that normal testicular function depends upon low scrotal position. Moore states that: "Not only is the congenitally retained testis in a degenerate condition but also an active mature testicle surgically removed from the scrotum with nerves, blood vessels, and vas deferens intact and placed in the abdomen shows marked degenerative changes within the period of a week. It shrinks progressively as the germinal epithelium becomes more degenerate and does not again produce sperm cells as long as confined in the abdomen. If prior to the loss of all residual germ cells the testis is replaced in the scrotum, recovery follows quickly and sperm cells reappear within approximately 60 days." The effect of orchiopexy upon fertility has not been adequately studied from a clinical standpoint. Few authentic records are available. Although McCollum revealed fertility in 82 per cent of bilateral cryptorchids after orchiopexy in contrast to the fertility of 10 per cent in those not operated upon, this would seem to far exceed even optimistic expectations for all cryptorchids.

CONCLUSIONS

It would seem that management of the cryptorchid could be improved by:

First—Careful examination of these boys with classification into groups as indicated.

Second—Because of the possibility of natural descent, observation until puberty or shortly thereafter is desirable for those in Group III.

Third—Except for boys with definite endocrinopathy, gonadotropic or androgenic treatment is unnecessary; and may, if injudiciously used, actually be harmful.

Fourth—From the standpoint of ultimate structure and position the Keetley-Torek procedure, or one of its modifications, seems best adapted surgically, and has given better results in our hands.

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EXTRASKELETAL OSTEOGENIC SARCOMA*

REPORT OF A CASE OF OSTEOGENIC SARCOMA OF THE LIP

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FROM THE SECTIONS ON SURGERY AND PATHOLOGY OF THE VICKSBURG CLINIC, VICKSBURG, MISS.

AREAS of calcification and ossification, and even of true bone formation, are not uncommon findings in certain inflammatory and neoplastic conditions, particularly in lesions capable of exciting localized hematomas or areas of necrosis. Calcifications and ossifications of this kind have also occasionally been observed in fibrosarcomas arising in soft tissues. In none of the latter instances, however, do the bone elements seem to be formed by the cells of the neoplasm.

In contrast to these relatively frequent observations, the neoplastic cells of a certain rare group of fibrosarcomas of the soft tissues apparently exhibit a perverted tendency to form bone. The perversion is accompanied by other manifestations of osteogenic sarcoma, including the presence of large numbers of foreign body giant cells of the osteoclastic type. Tumors in which this bone-forming process occurs are classified as extraskeletal osteogenic sarcomas.

In 1941, Wilson[1] was able to collect from the literature 30 cases of "bone-forming malignant tumors in the soft parts," to which he added ten other cases of "extraskeletal ossifying tumors," six from the Registry of Bone Sarcoma of the American College of Surgeons and the remainder from the Departments of Surgery and Pathology of the University of Chicago. Three of the ten new cases represented benign growths, and Wilson mentions other nonmalignant cases of extraskeletal ossifying tumors not included in the 30 cases of sarcoma which he collected from the literature.

Wilson points out that myositis ossificans offers problems of differential diagnosis, and it seems reasonable to assume that a case or two of this condition may possibly be included in the 30 cases he collected from the literature, because of the notorious tendency of myositis ossificans to simulate sarcoma histologically. Definite statements cannot be made on this point, since no attempt has been made to review the original material, but it might be said that such an error could occur only in a patient who was cured by local excision of his tumor. In most of the reports, because either recurrence or metastasis was demonstrable, the malignancy of the lesion seems beyond question.

Of the 30 extraskeletal malignant tumors collected from the literature by Wilson, seven, or nearly 25 per cent, were osteogenic sarcomas of the thyroid gland, and 12 or 40 per cent, were osteogenic sarcomas of the breast. Four tumors occurred in the thigh and one each in the gallbladder, the chest wall,

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the abdominal wall, the kidney, the mesentery, the vastus externus, and the gastrocnemius muscle. In Wilson's personal collection, two malignant tumors occurred in the thigh, two in the gluteal region, and one each in the arm, the leg and the mediastinum. The three benign extraskeletal ossifying tumors occurred, respectively, in the forearm, the retroperitoneal tissue, and the thigh.

The seven reported osteogenic sarcomas of the thyroid gland include the tumor reported by Broders and Pemberton,[2] which represented the single case of this kind observed at the Mayo Clinic in the course of pathologic examination of approximately 40,000 thyroid glands. An additional case of osteogenic sarcoma of the thyroid, not included in Wilson's series, was reported by Batts,[8] in 1940.

The twelve reported osteogenic sarcomas of the breast include three so-called "carcinosarcomas," a rare and possibly a distinctive type of tumor. The comment of Saphir and Vass,[4] that this term is used too loosely and that many cases reported in this category are simply pleomorphic carcinomas, is probably justified. On the other hand, we are ourselves convinced that a distinctive tumor of the mammary gland, containing both malignant epithelial elements and malignant connective tissue elements, really exists. We have in our collection of pathologic specimens a tumor of the mammary gland similar to the three carcinosarcomas in Wilson's series; it contains both malignant epithelial and malignant connective tissue. We are not reporting it at this time, partly because the clinical data in the case are inadequate and partly because we are unconvinced that it really belongs in the group of extraskeletal osteosarcomas, even though the causes for the formation of bone in extraskeletal sarcomas and carcinosarcomas are probably related.

If all reported sarcomas of the mammary gland containing osteoid elements were included in the category of extraskeletal osteogenic sarcomas, the series would be even larger and the preponderance of these tumors in the breast even higher than it is in Wilson's collected cases. The fibrous tissue of the mammary gland is apparently suitably disposed to the formation of bone, and, as Ewing[5] has pointed out, giant cells of the myeloid type occur in spindle cell and round cell sarcomas of the breast. The first cases of ossified tumors of the breast were reported by Boneti, in 1700, and by Morgagni, in 1769. In 1937, as Binkley and Stewart[6] noted, one author was able to collect 75 such cases from the literature. The collection is probably incomplete, partly because of the frequent difficulty of determining from the listed titles exactly what sort of case is being reported, and partly because many cases are undoubtedly not reported at all. Thus, Wellbrock[7] reported a mammary sarcoma of this general type in 1929, and, in 1933, demonstrated another similar tumor containing bone to one of us (J. C. H.), but to our knowledge has not yet reported it.

In addition to their possible origin in the tissues of the thyroid and the breast, it seems probable that some osteogenic sarcomas of the soft tissues may develop from old calcified hematomas or from foci of myositis ossificans. One case in Wilson's collected series could readily fit into this group, and in

three of the additional cases which he reported the patients had observed hard tumors, in one instance preceded by trauma, for 10 to 12 years before evidences of malignancy became manifest.

Turner and Craig,[8] who reported a personally observed case of osteogenic sarcoma of meningeal origin, studied calcification and ossification in meningeal tumors, and compiled a full list of references to the literature. They also discussed the possible reasons for the metaplasia of fibrous tissue. In the same connection, Wilson pointed out that extraskeletal osteogenic sarcomas have occasionally been produced experimentally by the injection of carcinogenic agents into fibrous tissues of rats.

There are two principal schools of thought concerning the development of osteogenic sarcoma in soft tissues. Broders[9] takes the position that after anaplasia of fibrous tissue cells has resulted in the development of sarcoma, the neoplastic fibroblasts go through a process of differentiation into osteoblasts, which are responsible for the formation of bone. Mallory,[10] like Leriche and Policard, regards osteosarcomas as fibrosarcomas passively ossified by the conditions of their environment. Whether an actual controversy exists between these two schools of thought is not entirely clear. Apparently, as Batts points out, the proponents of one theory imply that the osteoblasts of the tumor secrete a true osseous substance, while the proponents of the other theory believe that the osseous transformation of connective tissue is an interstitial and humoral process and is, therefore, a phenomenon independent of all cellular action. It is not known whether the differentiation of neoplastic fibrocytes into osteoblasts depends upon the inherent potentiality of the cells or upon their environment, although Broders has clearly demonstrated that from a morphologic point of view such a differentiation actually occurs in tumors of this type.

The case of extraskeletal osteogenic sarcoma of the lip which we are recording herewith is apparently the only one observed to date in which the growth occurred in this particular location. We have nothing to contribute to the theoretic considerations of the subject, except to confirm Broders' morphologic concept, and, therefore, prefer to avoid any controversy concerning the origin of this type of bone tumor.

Case Report.—D. H. G., white, male, age 53, was first seen at the Vicksburg Clinic May 29, 1935. His chief complaint was a small sore on the right side of the lower lip, which had been accidentally discovered two weeks before. His family physician had incised the lesion, but no improvement had followed.

The patient smoked an average of ten cigarettes daily but had never smoked a pipe. His previous history was without incident except for three operations—appendicectomy for acute appendicitis in 1903, hemorrhoidectomy in 1930, and left nephrectomy for ruptured kidney in 1931. An uncle and a first cousin had died of cancer.

General examination revealed nothing of note except several carious teeth and advanced pyorrhea; oral hygiene was poor. Local examination revealed a circular, indurated ulcer, 2 cm. in its greatest diameter, along the vermilion border of the right lower lip, midway between the midline and the angle of the mouth. The edges of the ulcer were brawny and were sharply outlined. The lymph nodes of the right submental space were palpable but those on the left were not felt.

Routine uranalysis revealed no abnormalities, and examination of the blood showed values within the normal range. Roentgenologic examination of the chest was also negative.

Biopsy of the lesion was performed May 30, 1935, and the specimen was examined by a pathologist elsewhere. He reported squamous cell carcinoma, Grade 4, which confirmed the tentative diagnosis of malignancy.

Operation.—June 3, 1935. Under nitrous oxide and ether anesthesia, a complete block dissection of the lymph nodes of the right side of the neck was carried out by the classical technic. In addition, the right sternomastoid muscle was removed, the jugular vein on this side was ligated, and its trunk, together with all demonstrable lymph nodes in the area was excised. The left submental and submaxillary lymph nodes were also removed, as were the submaxillary and salivary glands. Immediately after closure of this wound, a wedge-shaped excision of the tumor-bearing portion of the right lip was carried out through an appropriate incision and was followed by plastic repair. Convalescence was uneventful and the patient was discharged in good condition on the ninth postoperative day.

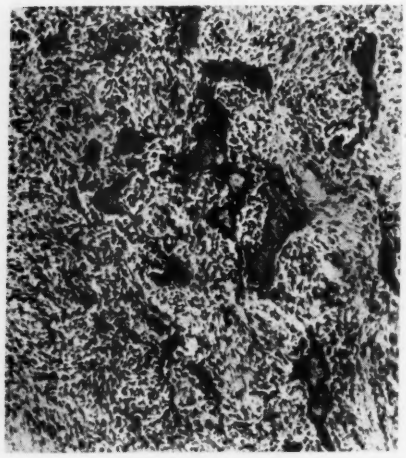

FIG. 1.—Section of osteogenic sarcoma of lip removed August 26, 1938, showing spicules of bone in relationship to other cells of the neoplasm. (×80)

The excised tissue was submitted to the same pathologist who had examined the biopsied specimen. He again reported that the tissue from the lip showed squamous cell carcinoma, Grade 4. The lymph nodes showed only inflammatory reaction.

The patient was observed at regular intervals and remained in good condition for the next two and one-half years. In January, 1938, he was admitted to the Medical Service of the Vicksburg Clinic for a cardiac condition which was diagnosed as angina pectoris. He was discharged improved after treatment. At this time there was no evidence of recurrence of the malignancy.

He was not seen again until August 24, 1938, at which time he presented a bulky recurrent tumor of the lower lip, extending from the right of the midline to the angle of the mouth. There was no evidence of cervical metastases, and roentgenologic examination of the chest revealed no abnormalities. The medical consultant considered the cardiac reserve adequate for surgery.

August 26, 1938, under ether anesthesia, two-thirds of the lower lip was removed *en masse*, and plastic reconstruction was carried out. Convalescence was smooth, and the patient was discharged in good condition on the seventh postoperative day.

In the meantime, the Vicksburg Clinic had established its own Section on Surgical Pathology, and the excised tissue was reported as follows:

The specimen consists of a segment of skin, mucous membrane and subcutaneous tissue from the lip, measuring 5 x 3 x 1.7 cm. Approximately 75 per cent of the specimen is made up of firm, white, fibrous tissue, the cut surfaces of which are slightly gritty. Histologically, the tumor is composed of pleomorphic spindle cells, including many giant tumor cells. Mitotic figures and monstrous bizarre nuclear forms are seen in abundance. Scattered diffusely through the tumor area are many giant cells of the foreign body type, and in several areas are fragments of fibrous osteoid tissue and spicules of true bone surrounded by osteoblastic cells, which shade off into adjacent parts of the tumor (Figs. 1 and 2). There is little evidence of hemorrhage or necrosis in the tumor, and the bone formation is apparently a product of the neoplasm rather

than a result of calcification. Further proof of this assumption is found in the fact that the spicules of bone are rather poor in calcium deposits outside of the osseous tissue. The epithelium of the skin and the mucous membrane evidently take no part in the neoplastic process (Fig. 3). *Pathologic Diagnosis:* Osteogenic sarcoma.

The diagnosis of osteogenic sarcoma was confirmed by Dr. A. C. Broders of the Mayo Clinic, who kindly examined the material.

At this time the microscopic section obtained at the first examination was restudied and a corrected diagnosis of osteogenic sarcoma was made. It was evident, however, that it would have been difficult to make this diagnosis originally, because on the available slide the bone had been torn away by the microtome knife and only small spicules of bone and a defect in the section remained. On restudy of the section, however, osteoclastic giant cells were plainly evident, and the general tumor cell morphology was similar to the morphology observed in the recurrent tumor. As a matter of fact, the pathologist who made the first examinations had previously recognized the unique character of the tumor, since he had called attention to the presence of giant cells and had graded the malignancy 4, which is unusually high for carcinoma of the lip.

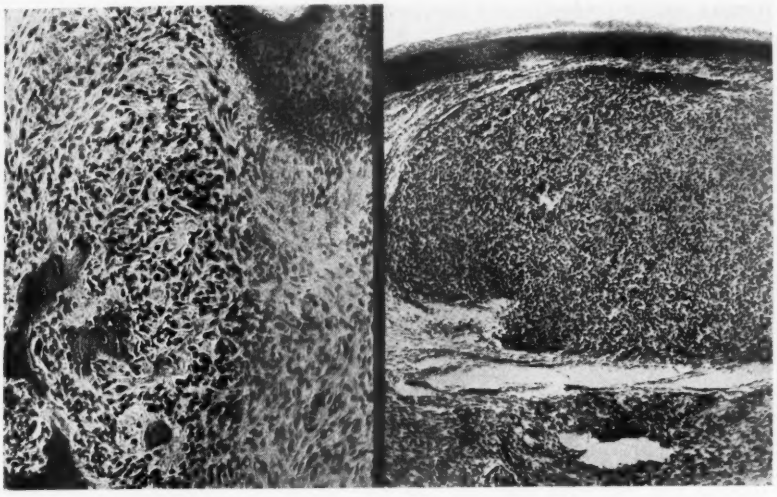

FIG. 2 FIG. 3

FIG. 2.—Higher power view of section of osteogenic sarcoma of lip with spicules of bone. Note the portion of mucous membrane visible in one corner. (×125)

FIG. 3.—Section of osteogenic sarcoma of lip removed August 26, 1938, showing relationship of lobule of tumor to mucous membrane. Note artefact in deeper portion of section, where a spicule of bone has been torn from the tissue by the microtome knife. (×55)

When the patient was examined four months after operation there was no evidence of recurrence and his general condition was good. Two months later, however, the tumor had recurred, and fixation to the mandible, confirmed by roentgenologic examination, was observed for the first time.

Second Operation.—The affected area was explored March 15, 1939, under nitrous oxide and ether intratracheal anesthesia. An incision through the reconstructed lower lip at the midline was extended laterally to the right mandible and exposed a large mass, which involved both the mandible and the floor of the mouth on the right. The mandible was divided in the midline and the tumor-bearing bone, with a wide area of adjacent apparently normal bone, was resected, together with the affected portion of the floor of the mouth. No attempt at repair was made. The wound was packed and the skin was partially approximated with interrupted silk sutures.

Postoperative therapy, in addition to routine measures, included the use of the

duodenal tube and an indirect transfusion of 500 cc. of blood. The patient died 24 hours after operation. Necropsy was unfortunately not permitted.

Microscopic examination of the excised tissue revealed no bone in the areas sectioned, and no attempt on the part of the tumor cells to differentiate into osteoblasts.

COMMENT.—One of the most interesting and most curious features of this case is the relatively long period of well-being (more than three years) between the primary operation and the first recurrence, as compared with the rapidity of the second recurrence (within seven months).

Since the tumor involved the mandible at the time of the second recurrence, the question naturally arises as to whether it involved the bone originally. We are quite certain that it did not. All the evidence, including the prolonged period of quiescence following primary resection of the lesion, pointed to a truly extraskeletal character of the lesion, and roentgenologic study at the time of the second recurrence revealed the type of secondary involvement likely to be found in far-advanced cancer of the lip rather than a primary tumor of the bone.

SUMMARY

(1) A review of the literature of extraskeletal osteogenic sarcoma clearly indicates the rarity of this type of neoplasm. To date less than 50 cases seem to have been reported.

(2) The largest number of reported cases originated in the mammary gland, and the next largest number in the thyroid gland. It is quite possible that a few tumors may have been derived from extraskeletal bony deposits, such as calcified hematomas or foci of myositis ossificans.

(3) An additional case of extraskeletal osteogenic sarcoma is reported, and is apparently the first to be recorded in which the growth occurred in the lip. Radical operation was carried out within three weeks after the lesion was first observed, and the patient remained free from recurrence for three years. Radical surgery was again performed, but a second recurrence took place within seven months and death followed operation for its removal.

The authors regret that the article "Primary Osteogenic Sarcoma of the Bladder" by Crane and Tremblay, ANNALS OF SURGERY, **118**, 871–886, November, 1943, came to their attention too late to be included in the discussion of the literature in this paper.

We wish to express our appreciation to Drs. A. C. Broders and John R. McDonald, of the Mayo Clinic, for their help and encouragement in the preparation of this paper.

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DISCUSSION.—DR. JOHN C. HENTHORNE, Vicksburg, Miss.: The photomicrographs of the tumor Doctor Parsons has just reported demonstrate (1) spicules of bone in the tumor; (2) relationship of spicules of bone to the fibrocytes of the tumor and; (3) the general configuration of lobule of tumor and its relationship to the mucous membrane which evidently takes no part in the neoplastic process. At the top of this last slide is an artefact evidently produced by the microtome knife, which tore a spicule of bone from the tissue at the time the section was prepared. An artefact of this type appeared in the slide prepared from the first tissue removed from this patient, and evidently prevented the pathologist from making the correct diagnosis of osteogenic sarcoma.

COL. BRADLEY L. COLEY, New York City: There is probably more confusion in the diagnosis of bone-forming tumors that arise in muscles contiguous to bursae than to those arising in the breast and lip. We have recently seen one in a soldier, involving the soft tissue adjacent to a tarsal bone. The section was reviewed by Dr. Fred Stewart at Memorial Hospital, who stated that it was a malignant synovioma. Since they can occur in a bursa or tendon sheath some distance from bone, they could and do, in some instances, resemble quite closely an osteogenic sarcoma. Reference has been made to osteogenic sarcoma arising extraskeletally. We have observed a case which occurred in the muscles of the thigh quite apart from the femur. An additional rare case, arising in the pericardium, was found at autopsy at Memorial Hospital. This case was reported by Binkley and Stewart in 1940 in an article dealing with extraskeletal osteogenic sarcoma and pseudosarcoma.

I would like to emphasize the difficulty Doctor Parsons mentioned in differentiating these tumors histologically from myositis ossificans. I can recall two instances of wide variation of opinion among a number of eminent pathologists. One case was thought by three of these distinguished microscopists to be osteogenic sarcoma, but proved to be myositis ossificans. The other instance is one which was thought to be osteogenic sarcoma, by the pathologists at Memorial Hospital, and also proved to be myositis ossificans. In both these cases radical surgery was fortunately avoided. I think one must take advantage of the services of the radiologists, and study particularly the clinical aspects of these cases to avoid unnecessary amputation, which in the past has occasionally been performed for what ultimately proved to be myositis ossificans. And I often wonder whether some of the five-year cures of the older literature may not be, in reality, examples of this sort.

Doctor Parsons is to be congratulated on the clear way in which he has brought this interesting subject to our attention.

DR. BARNEY BROOKS, Nashville, Tenn.: The condition reported by Doctor Parsons reminds me of a case which was operated upon in Vanderbilt University Hospital only a few months ago, in which a small nodular tumor of the lower lip proved on microscopic examination to be a characteristic "mixed tumor of the parotid region," containing bone and cartilage. I mention this merely because of the possibility of the tumor reported by Doctor Parsons having had its origin in a preexisting mixed tumor.

DR. JOHN C. HENTHORNE, Vicksburg, Miss. (closing): I wish to thank you for your interest in the paper, for Colonel Coley's remarks and for those of the Chairman.

Colonel Coley's reference to synovioma is interesting, since tumors of this type are rare and evidently of very serious nature. Several years ago, I encountered a synovioma of the knee joint and looked up the literature at that time. In one paper there were 29 cases collected from the literature, and all had died from metastases of the tumor. Our own case died about 18 months after onset of symptoms. Colonel Coley's case of extraskeletal sarcoma of the thigh is similar to one reported by Wilson from the Bone Sarcoma Registry of the American College of Surgeons, and that case may have been submitted to the Registry by Colonel Coley. It is cases of this type that suggest the possible origin of extraskeletal osteogenic sarcomas from calcified hematomas or foci of myositis ossificans.

The case of osteogenic sarcoma of the pericardium reported by Colonel Coley also suggests the possible origin of tumors of this type from previously established foci of calcification, because such foci do occur in the pericardium.

Colonel Coley's remarks about myositis ossificans are also pertinent. Doctor Geschickter once said that Doctor Halsted and Doctor Bloodgood used to play a game with each other in which one would unexpectedly show the other a slide from a known case of myositis ossificans, and either one would occasionally make an erroneous diagnosis of sarcoma, much to the amusement of the other. If these men had difficulty with the microscopic diagnosis of myositis ossificans, certainly the rest of us should be careful in differentiating extraskeletal osteogenic sarcoma from myositis ossificans.

Doctor Brooks' mention of a mixed tumor occurring in the lip is also pertinent in that he suggests another possible origin for the tumor we are reporting. Since mixed tumors of the parotid gland type occur in other glands, the occurrence of such tumor in the lip is not surprising. Mixed tumors have myxomatous tissue, and less frequently cartilage and bone in their stroma, and since the presence of myxomatous tissue frequently presages formation of cartilage and bone, there is a possibility that some extraskeletal osteosarcomas may arise from myxomatous tissue. Myxomatous degeneration of the fibrous tissue in fibro-adenomas of the breast is also a relatively common phenomenon and since, as we have pointed out, the fibrous tissue of the mammary gland seems to be suitably disposed to the formation of osseous tissue, myxomatous changes of the fibrous tissue may possibly precede this osseous transformation.

In our case, the rapid development of the osteogenic sarcoma had obliterated any traces of myxomatous tissue or mixed tumor that might have been present previously.

THE VALUE OF NONPROFIT BLOOD BANKS FOR CIVILIAN USE: AS PLANNED BY THE OFFICE OF CIVILIAN DEFENSE*

WITTEN B. RUSS, M.D.

SAN ANTONIO, TEXAS

THERE seems to be no limit yet in sight for the amount of plasma required by both the armed services and civilian population. Wide publicity is being given to the often repeated statement that blood plasma outranks even skillful surgery and the sulfa drugs in lowering mortality and morbidity from casualties of battle, and, the experience in handling shock and especially burns in civil life seems to confirm that statement. This, therefore, means that the demand for blood and plasma reserves for use by civilians will continue to increase.

Donor procurement by the American Red Cross and commercial laboratory facilities for preparation of plasma for the armed services is already taxed to the limit. Everyone agrees that the armed services must come first, but civilian needs cannot be neglected. To meet these requirements, the Office of Civilian Defense and the U. S. Public Health Service have worked out a program. Volunteer donors are being used to build up community plasma reserves, and hospitals are processing blood on a nonprofit basis. No limit is yet in sight for the amount of plasma required. Unless some substitute for human blood is found, it will tax the hospitals of this country, even with all-out community support, to supply that demand.

On June 30, 1943, when the appropriation provided by the U. S. Public Health Service terminated, O. C. D. grants had been made to 168 hospitals, which have pledged 79,000 units of plasma. In addition to this, other hospitals operating blood and plasma banks independently have placed their plasma reserves (about 3,300 units) under control of E. M. S. of O. C. D. There are at present available 160,000 units of plasma stored in 675 storage depots in 382 cities of the United States.

To quote from a paper recently read before the A. P. H. A., Dr. John B. Alsever, Chief of Blood Plasma Section, O. C. D. states: "Today there is no question of the tremendous value of plasma in saving the lives of persons who have been seriously injured, whether it be on the battle fronts or on the home front. It is now known that in all severe injuries there is a loss of circulating blood volume into the injured tissues as well as loss by hemorrhage. This causes the circulation to become inadequate, resulting in tissue anoxia and shock. The shock state may terminate in death if adequate prompt treatment is not given. If the blood volume is restored within a few hours after the injury and maintained at an adequate level, an individual

*Read before the Southern Surgical Association, December 7–9, 1943, New Orleans, La.

can recover from very severe trauma. The special value of plasma is that, like whole blood, it restores blood volume physiologically, except for the red cells which have been lost through bleeding. Unlike whole blood, it can be made available in large amounts, can be stored over long periods of time, and can be administered without reference to blood group, cross-matching, or skin-testing. Plasma, like whole blood, is far superior to salt solution, glucose, or acacia for treating shock.

"It should be emphasized that plasma must not be considered to have completely replaced the use of whole blood in the treatment of shock. In fact, if it is immediately available, whole blood is preferable to plasma if the shock is due to hemorrhage. However, even in a case of severe hemorrhage, plasma in adequate amounts is life-saving and should be used if whole blood is not immediately available, for this can always be given later on. A person cannot survive long without a blood volume large enough to maintain adequate circulation, but he can survive a severe degree of anemia.

"Unfortunately, there is no rule or formula by which one can determine the amount of plasma necessary in a given case. The only safe and practical procedure is to give enough plasma to achieve the desired result; namely, restoration and maintenance of normal blood volume. Time does not allow for a detailed discussion of dosage, except to say that a severely burned person may require three to six liters of undiluted plasma in the first 72 hours, and that at least one to 1.5 liters are required in cases of severe injury.

"Since April, 1942, when the Public Health Service began this plasma program, over 5,000 units of plasma have been used by the grantee hospitals in the treatment of their regular patients as well as the victims of civilian disasters. The excellence of the technic employed by these hospitals in preparing and administering plasma is evidenced by the fact that they have experienced less than 1 per cent of reactions with its use. These have been of the pyrogenic or urticarial types, which are rarely severe. The number of reactions reported is very close to the irreducible minimum which may be expected to accompany the intravenous administration of fluids.

"The plasma reserve and the organization for distributing it have proven their value many times. One of the first incidents in which these reserves were used was the Cocoanut Grove disaster in Boston. In all, 1,308 units of plasma were used to treat 181 burned patients, most of whom lived. Their survival was due, in large part, to the prompt administration of adequate amounts of plasma. Of the plasma used, 833 units came from the Civilian Defense reserves in Boston, which amounted to 2,800 units at that time. The remainder was supplied by the U. S. Navy and the Red Cross.

"In Rochester, New York, 57 units of plasma were used to treat 15 workers injured in an explosion at the Rochester Fireworks Company. Five workers burned in an explosion at the Tidewater Oil Company plant at Bayonne, New Jersey, required 24 units. Some of the other incidents in which these plasma reserves have been used are: The crash of a bomber into a Seattle, Washington, packing plant; an explosion in a munitions plant

at Elkton, Maryland; a war plant fire at Amsterdam, New York; the explosion at the Congoleum-Nairn plant in Kearney, New Jersey; the wreck on the Pennsylvania Railroad at Philadelphia; the Lackawanna Railroad accident at Wayland, New York; and the hotel fire in Houston, Texas.

"On several occasions plasma has been supplied to Army, Navy, and Coast Guard stations in this country to meet an emergency when their own plasma was not immediately available in sufficient quantity. Such a case occurred last May, at Abilene, Texas, when a column of soldiers marching at night was run through by a motorist. Plasma was requested at about 1 A.M. from one of our grantee hospitals at Fort Worth, and was delivered to the Station Hospital, 150 miles away, by the Civil Air Patrol within one hour after the request was received.

"The establishment and operation of blood and plasma banks in the larger hospitals has proven to be of great value in improving the treatment of the sick and injured. Although the most spectacular results are seen in the treatment of traumatic and burn shock, the ready availability of blood and plasma is resulting in better preoperative preparation of surgical patients who show decreased plasma proteins or anemia. Likewise, the adequate and prompt replacement of the blood loss which accompanies major surgery, prevents shock and keeps the patient in excellent condition during the operation. This permits the longer surgical procedures to be carried out without the need which so often exists to "finish the operation before the patient goes bad." Further transfusions of blood or plasma are often indicated during convalescence because of continued anemia or depletion of blood proteins. Convalescence is smoother and shorter when the blood components can be kept within normal limits. The blood bank also facilitates the treatment of the anemias, blood dyscrasias, and acute infections.

"It is my belief that hospitals, equipped to prepare plasma and store plasma in the frozen state, will find increasing use for it in the treatment of infectious disease."

It is definitely the responsibility of the medical profession and the hospitals to give all-out support to both the Red Cross donor procurement service for the armed forces and to the independent program of the Public Health Service and the Office of Civilian Defense. No greater service could be rendered in support of the war effort and surely, the urgent need for blood plasma, during and after the war is manifest.

Blood *purchased* from donors and processed on a commercial basis is too small in amount and far too expensive to meet civilian needs. The Civilian Defense program now being operated in conjunction with U. S. Public Health Service seems to offer the best available means for meeting the rapidly expanding civilian need, but without the active support of the medical profession, hospitals and full cooperation by federal, state and local health agencies, the press and the general public, even the excellent O.C.D. program now in operation, under the able leadership of Doctor Alsever, will be inadequate.

DISCUSSION.—DR. CHARLES R. EDWARDS, Baltimore, Maryland: I happen to come from the State of Maryland which, under the administration of our late Governor, was a free state; I do not know its exact status now. I want to say something in support of Doctor Russ' contention. Of course you know that the Red Cross has provided great quantities of blood plasma and in Maryland, of which state I happen to be Director of Emergency Medical Service, we have made an attempt to develop existing facilities and to employ no new agencies. With that in mind, all hospitals in a position to do so were asked to develop their facilities for processing blood—frozen or dried plasma, *etc.* We have gone a little further and worked for all our demands for blood. Hospital officials and public health officers throughout the state have formed a committee and attempted to line-up a great many people who might, on sudden call, be asked to donate blood. Everybody who goes to a hospital to donate blood for relatives or friends is asked to go on this list. The blood is typed, a record is made, and the individual gets a duplicate card. A letter is written him asking that he have his name put on the official roster, and if an emergency comes a request is sent to him to report to the hospital nearest which he lives. So far there have been no refusals, and by the end of this month we will have 50,000 people on this list.

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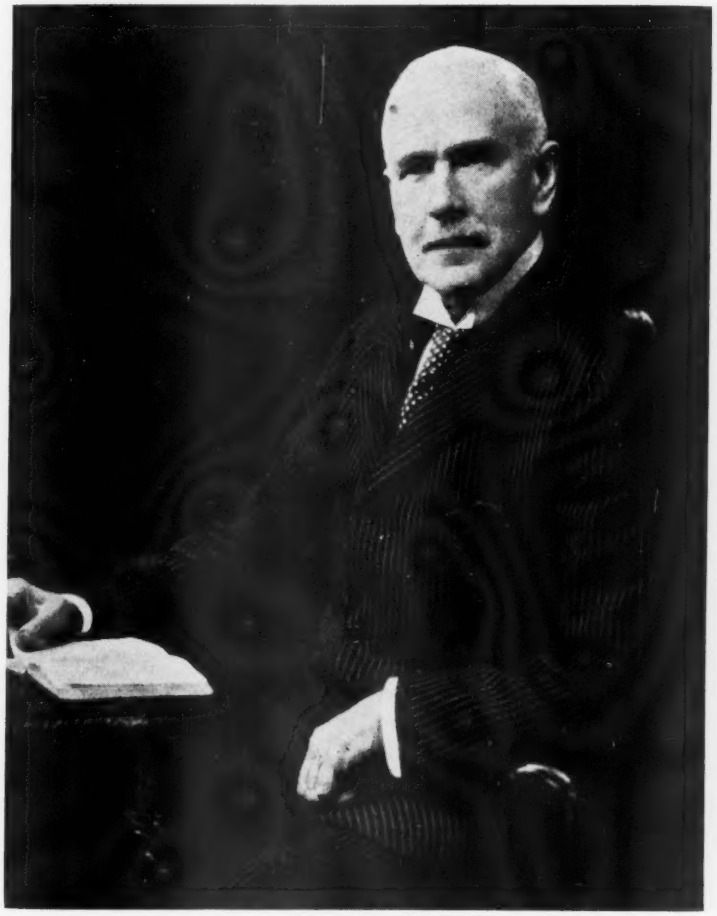
MEMOIRS

SIR WM. ARBUTHNOT LANE, BART., C.B., F.R.C.S.

1856–1943

Sir Wm. Arbuthnot Lane was born at Fort George, Inverness, Scotland, July 4, 1856, and died in London, January 16, 1943, at 86 years of age, the son of Brigade Surgeon Benjamin Lane, Lic. R.C.S. Ireland, and was



educated at Stanley House, Bridge of Allan, Scotland. He received his Bachelor of Medicine (M.B.) and Master of Surgery (M.S.) from London University, followed by the usual F.R.C.S. England.

He qualified from Guy's Hospital when he was only 21, and less than ten years later was appointed surgeon to Great Ormond Street Hospital, and then to the staff of Guy's Hospital, where he attained his greatest prominence

He was created baronet in 1913, Comp. Bath in 1918, F.A.C.S. (hon.) in 1925, Chevalier of the Legion of Honor, *etc.*

He had visited the United States frequently, and in October, 1925, came especially to deliver the annual Murphy Oration at the Clinical Congress of Surgeons held in Chicago that year. He was at that time close to his seventieth birthday, and about to retire from active service at Guy's and at the Great Ormond Street Hospital for Children, where he had been the center of attraction for over a quarter of a century, especially to American medical tourists, who flocked to his clinic and regarded no visit to London complete without paying him a call and seeing him operate. These friendly relations made him sure of a cordial reception whenever he came to the United States, especially on this visit to Chicago, where he was to reap the laurels of an international friendship which had been planted and cultivated for over three decades.

An anatomist and surgeon by inclination and long culture, his authority had been long recognized since early years, when he published an excellent anatomical guide, made particularly valuable because of its surgical applications. He had also become an authority in osteology because of his notable thesis in which he particularly studied the changes in the skeleton consequent on the stress and strain to which it is subjected by different occupations, illustrating his observations by detailed studies of the anatomy of the coal-heaver, the shoemaker and the charwoman, out of which his general conclusion still remains true to the effect "that we bear a simple mechanical relationship to our surroundings. Any change in that relationship produces a corresponding alteration in our anatomy."

In his early years he also became notable by his successful ligation of the internal jugular vein to prevent metastatic infection of the lungs from septic lateral thrombosis following middle ear and mastoid disease. Previously, this procedure had been suggested and carried out in one instance by Victor Horsley, who performed the first jugular ligation for this cause in 1888, Lane following immediately in 1889. These and other original innovations soon led to his appointment as Chief Surgeon at Guy's and at the Great Ormond Street Hospital, where he held sway until the day of his retirement.

His thorough anatomical and physiological foundation made him a bold and yet safe operator, original and resourceful, and always imperturbable in his calm, British self-possession. He seemed to know no limit to the anatomic regions over which he practiced his art. He was as much at home in dealing with the extremities as in the head, neck, and trunk; in the joints and bones; in extirpating the colon, or doing a cleft palate; in ligating and excising the internal jugular vein to check an acute otitic infection on its fatal way to the lungs.

In one morning at Guy's I saw him do an unusually difficult palatoplasty for cleft palate in a small child, a resection of the lower jaw for malignant disease, an open reduction and plating of both bones of the forearm for fracture, and a total colectomy, from cecum to sigmoid, with a terminal

ileosigmoidostomy, by his method of anastomosis—for the relief of what is still known as "Lane's disease." Upon all these operations he stamped the seal of his personality by the originality of his procedures and the smoothness, ease, and perfection of technic that proclaimed a real master, a master who dared where others quailed and who succeeded where others would have failed without his skill, his precision, and the confidence with which he planned and executed his operations.

His special interest in the anatomy and pathology of the skeleton led him to direct his attention to the treatment of fractures and to his dissatisfaction with the results obtained at that time with the classical modes of treatment. Lane's early contention and insistence that the surgeon should do as neat a job "when repairing broken bones as a cabinet maker in mending the legs of broken chairs," was the starting point of his early pleading (Lancet, May 26, 1901) for more thorough and perfect adjustment of broken bones. With the dawn of asepsis and the advent of the roentgen rays, the open treatment of fractures became a possibility, which Lane soon converted into a habit—and even into an obligate routine—whenever the classic methods of closed reduction failed to bring the broken bones into perfect apposition.

Lane's Plates and the Open Treatment of Fractures.—To accomplish this purpose, Lane invented the perforated steel plates which were screwed to the bones and allowed to remain permanently embedded. The simplicity of this procedure and the ease with which it generally accomplished its purpose, immediately gave Lane's plates a warm reception all over the world.

The story of Lane's plates and their vicissitudes is too well known to justify rehearsal here. Suffice it to say that, though it appeared for a while that Lane's plates were destined to the same oblivion that ended the glory of the Murphy button, they have not only survived all the criticisms to which they have been subjected, but are now serving their purpose in many modified forms and ways, far beyond Lane's most sanguine expectations. A better knowledge of their indications, and especially the introduction of the neutral metal vitalium by Venable, of San Antonio, as an alloy which is practically inert in the tissues—now used as a substitute for Lane's earlier steel plates—has not only rehabilitated the Lane plates, but has made them in principle one of the outstanding contributions to the advance of bone surgery.

Perhaps no more striking illustration of the diversified effects of Lane's principle in the development of bone surgery could be quoted, than the magnificent triumph achieved by Surgery in solving the problem of the broken hip (fractured neck of the femur) which for centuries has challenged the best of surgery to make this rebellious fracture amenable to its curative laws. Here we see contemporary surgery's most brilliant accomplishment in redeeming thousands of helpless crippled men and women all over the world, now happily restored to independence and usefulness by the skillful application of Lane's practice as applied and interpreted with great originality and ingenuity in America, by surgeons such as Smith-Peterson, the pioneer, and his host of followers in the orthopedic and surgical ranks. Suffice it to consult

the textbooks of the last quarter century to realize what a tremendous distance we have travelled in the treatment of broken bones since Lane led the way to the goal.

Lane not only gave a new outlook to the treatment of fractures, but he created a veritable renaissance for the mechanical therapy of skeletal traumatisms by the impulse he gave to the invention of innumerable instruments for the open reduction of fractures that now fill the catalogues of surgical instrument makers, including the large fixation clamps on which he depended to obtain an absolute control of the broken fragments while screwing on his plates. He used no extension tables or apparatus to relax muscular spasm or to bring the bones into apposition, depending solely on sturdy assistants to handle and steady the limbs until he had obtained the perfect fixation of the broken ends.

One of the striking features of Lane's bone instruments was the great length of their handles, which permitted all the work of reduction and bone plating to be done without manipulation in the wound itself. The procedure which he described as "no touch technique" aimed at the avoidance of infection from leaks in gloves and other sources. He had acquired great dexterity in working outside of wounds by constant performance with these tools, a dexterity which he also required of his assistants. He was satisfied with this technic, which gave a special cast to his armamentarium, and contributed no little to the aseptic results of his bone surgery. There is no better tribute to the excellence of his performance than the results recorded in his book, "Operative Treatment of Fractures" (2nd edition, 1914), which records the unique and unsurpassed experience of 22 years in the application of his methods.

Intestinal Stasis: Colectomy.—Early in his surgical career Lane became impressed with the importance of the intestinal tract as a source of chronic intoxications resulting from dietetic errors. He became a firm believer in Metchnikoff's teachings, which led him to say that it was no exaggeration "that we suffer and die through the defects which arise in our sewerage and drainage system,"—an opinion which was accentuated by Pauchet of Paris, who, after Lane, was the most experienced in successful colectomies in Europe, and who added that "intestinal stasis was the cause of nearly all the pathology of civilization." Lane was absolutely convinced that chronic intestinal stasis was the cause of cancer of the colon and even elsewhere, especially when stasis was aggravated by mechanical obstacles in the path of the fecal current, such as a kink in the bowel caused by adherent or acquired peritoneal bands, thereby causing friction and irritation at the point of obstruction. It was here that the "Lane kink" figured large as a permanent cause of colonic morbidity, and it was the kink in the right colon and at the sigmoid flexure that Lane so insistently described, and that kept radiologists busy for many years demonstrating it to surgeons, who were kept still busier for many more years performing celiotomies to straighten it out.

The kink and stasis predisposed to the elongation and to the prolapse

of the bowel and the viscera (viscero- and enteroptosis), "to rheumatoid arthritis, tuberculosis, arteriosclerosis, to epilepsy, and above all to cancer." The difference between chronic intestinal stasis and plain constipation was that in chronic intestinal stasis the stagnant pool of feces in the colon became definitely infected with pathogenic germs which brewed the toxins which were absorbed and carried everywhere in the organism by the circulation. In this way the familiar picture of visceroptosis and its usual accompaniment, cardiovascular asthenia, *etc.*, evolved into the protean picture which was identified as "Lane's disease."

It is from this pathologic background that the operation of *radical* or *complete colectomy* was evolved, which Lane conceived as the only possible remedy for the disease before it reached its terminal stages; and it was based on this conviction that Lane performed colectomies more frequently and for more numerous indications—but far more perfectly and successfully—than any other surgeon in the world.

To those who, like the writer, have watched Lane perform a total extirpation of the colon, his very small operative mortality was not at all surprising. One could not see Lane perform this exacting and technic-testing operation, without feeling that he had seen something done as well as it could possibly be done. Lane's incomparable perfection as an abdominal technician in this special field was based largely on the following distinct features: (1) Free incision, permitting adequate exposure of the abdominal contents, their inspection and palpation. (2) Speed without haste. Lane did not strike a casual observer as a rapid operator, yet the colon was removed from cecum to sigmoid, the terminal ileosigmoidocolic anastomosis performed, and the peritoneum closed, well within an hour. But this could not have been possible without making every act purposeful and in uninterrupted continuity, and the entire absence of haste. (3) Lane made a real advance in intestinal surgery when he showed that the large intestine could be joined to the small without risk by an end-to-end anastomosis. He showed that this actual anastomosis possessed no special risks, and had every advantage over an end-to-side ileocolostomy, which had to be abandoned because it failed to obviate the objectionable and dangerous regurgitation of the fecal current into the blind end of the colon, causing its enormous distention and compelling a colostomy for its relief. (4) Another important feature of his technic was insertion of a rectal tube through the anus to a point in the ileum well above the anastomosis for the purpose of preventing flatulent distention above the line of the ileocolonic joint. Furthermore, he was ahead of most of his British contemporaries in his effort to prevent postoperative shock and dehydration by preceding the operation and continuing it under the steady flow of a saline solution by hypodermoclysis; a procedure known in his clinic as the "axillary sup," which we carried on in our clinic in New Orleans for the same purpose by the continued intravenous glucose-saline drip.

Lane was so impressed with the view that cancer and the great bulk of diseases in civilization were due to errors of diet and improper feeding that

he founded "A New Health Society" which was organized essentially as a crusade for the prevention of cancer—a prophylactic aim which could only be made effective by complete revolution in the food and dietetic habits of the people.

Lane was so enthusiastic in his concept of the dietetic origin of disease, and especially of cancer, that he retired from his surgical practice, in which he had attained the greatest eminence, seemingly without regret, to assume the direction of the "New Health Society" which he had founded and organized, and which, if it had ultimately succeeded in its purpose, would have deprived surgery of some of its most heroic chapters, including some of Lane's greatest triumphs.

In conclusion, we may truthfully say that Lane expanded the surgical horizon by directing the profession to new surgical possessions and achievements (open reduction of fractures and fixation with Lane plates; intestinal stasis and Lane's kink, perfected colectomy technic; Lane's operation for cleft palate and pioneering in jugular ligations to prevent pulmonary metastases from ear infections) many of which we are now cultivating with profit and the promise of still greater benefits. Whatever may be the ultimate destiny of Lane's later concepts and theories regarding dietetic errors as predisposing to intestinal stasis, cancer, and other disorders that afflict civilized man, we know that these theories were conceived in good faith and with profound conviction of their truth, and that even if they have not been confirmed in all his conception of their importance, they have left a residue of value to the future, as the result of their discussion and controversial agitation. With us as surgeons, his memory will remain conspicuous and radiant, as that of a great practitioner of our art, a real virtuoso, a magnificent technician, and a pathfinder whose name will remain honored and indelible as that of a man who made surgery better by his presence and his deeds.

He was married twice, first, in 1884, to Charlotte, daughter to John Briscoe, with whom he celebrated his golden wedding; and later, to Jane, daughter of the late Mr. N. Mutch.

He leaves a son, William Arbuthnot, who succeeds to the title, and three daughters.

R. MATAS, M.D.

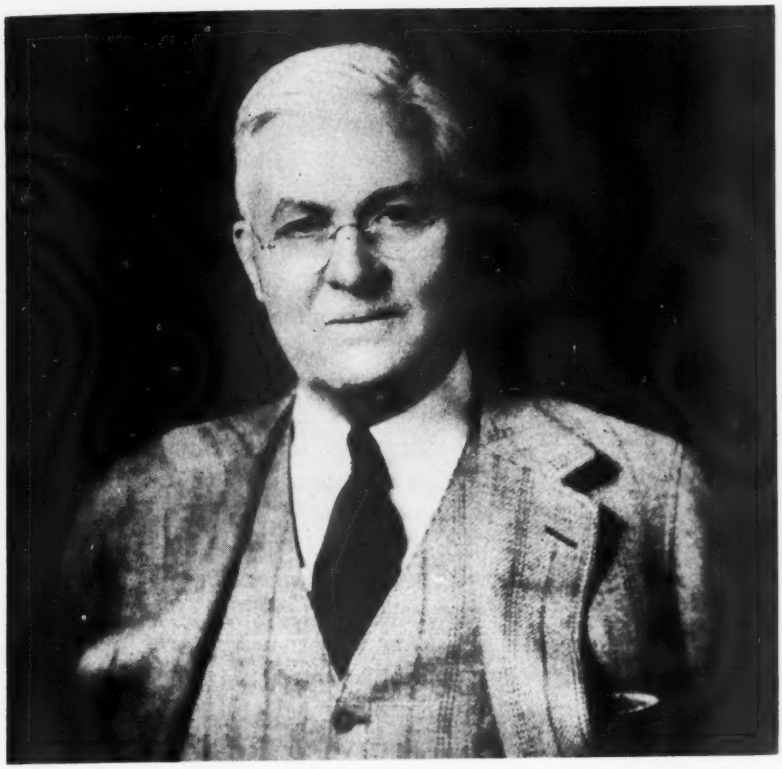
GEORGE CRILE

1864–1943

To write the obituary of an intimate friend is a difficult assignment, in any case, and the task is particularly hard when that friend was George Crile. The easiest way would be to compile the usual dates, to list his positions, to cite his military service, and to append a list of his awards, honors and publications. These activities and achievements are so well known to members of the medical profession, however, that I shall leave it to others to assemble the record. I

prefer rather to comment on him and his work, as I knew him throughout a lifetime of close personal and professional association.

He had a unique personality, and doubtless would have been an outstanding figure in any profession. With his personal charm, his keen intelligence, his handsome bearing, his abundant energy, and his zest for knowledge, he could not fail to succeed in anything he might have undertaken. Fortunately for our profession, he chose to devote to medicine and surgery his talents and energies,



and his enthusiasm. Perhaps enthusiasm was his dominant characteristic, for he never did anything he could not do enthusiastically. His abundant zest was infectious, and spread to those who worked with him and to his patients. As a physician he had an almost mesmeric quality in relieving the anxiety of the sick.

His skill as a surgeon needs no comment. His dexterity—in fact, ambidexterity—and sharp clean dissection were inspiring to a whole generation of students and surgeons who observed his work in the operating room. As a surgeon he had the confidence born of skill, and the imagination and courage to attempt procedures that carried risk, if he felt that they might be successful in alleviating suffering or prolonging life.

Above all, though, George Crile had a quest and a vision that he pursued throughout his entire adult life with a devotion amounting almost to mystic fervor. This is the striking thing that distinguished him from other surgeons and that gave special meaning to his life. He was not content to make use of

known truths, but was forever searching for the answer to "What is Life?" This was the stream into which his tremendous energies flowed, and all his activities and observations were purposeful and tributary to this.

As a practicing surgeon, he knew at first-hand the barriers and obstacles created by the unknown, so he devoted his life to trying to extend the frontiers of knowledge that would help in solving surgical problems. It was apparent to him immediately that many of these problems could not be solved merely by accurate diagnosis and technical skill. They could be conquered only by an understanding of the processes of life and death. Hence, his activities were directed to investigation of these fundamental questions, because he knew that they would provide the answers for many specific surgical problems.

He never ignored an opportunity to learn from evidence at hand. Always he was observing, recording, correlating, devising theories and planning experiments to substantiate them. No observation was too insignificant to engage his attention, if it offered some small clue to the answers he was seeking. In conversations and discussions with his colleagues he was alert to grasp any chance remark that might have a bearing on the problem he was studying. Thus his work never degenerated into routine for he was always the investigator.

During his earliest years of medical practice, he made detailed observations on his cases and kept careful records, with special emphasis on the results of shock. He eagerly embraced every opportunity to learn more about it. In one of his earliest records, he describes an operation he performed on a severely injured patient who died while he was operating. In the case history, one reads the notation: "The operation gradually merged into an autopsy."

The stress of his duties as surgeon and teacher was never too great to prevent his continuing the search constantly. On the battlefields of the last war, it was carried forward. This experience gave him the opportunity to engage in studies on shock on a tremendous scale, and he took advantage of it. Later in his life, the search led him to the jungles of Africa, to the frozen North, to make first-hand observations on men and animals of different environment backgrounds. Toward the end of his life, when he was seriously injured in an airplane crash, he calmly made observations on himself and others and directed first aid measures, although he was unable to move from his seat. Still later, when he was handicapped by physical infirmity, he continued his laboratory investigations, and in his last illness, he observed his own subjective symptoms with the same intellectual detachment and curiosity with which he had observed so many others, and to his last conscious moment he was seeking the answer to the questions pertaining to life and death.

He early came to the belief that the function of all living things could be explained on a biophysical basis, and that life was an electrochemical mechanism. On the basis of this theory, he likened human function, in its most elemental form, to a battery that could be charged and discharged. When the capacity for recharging was destroyed, or if, for any other reason, there was no difference in the electrical potential, death ensued. Hence, he set out to

investigate various factors that would discharge and exhaust the function of life. This led to his researches on sleep, and physical measurements of effects of various injuries and drugs, particularly anesthetics. It also led to his investigations on the properties of cells.

Perhaps the greatest contributions he made to surgery were in the field of anesthesia, and in development of the principle of anoci-association, as it pertains to the reactions and response of the patient, both physically and psychically. He had shown that animals could be exhausted, even to death, by depriving them of sleep. He also observed similar phenomena in soldiers during the last war. The same effects could be observed following various methods of traumatism in animals, even under complete anesthesia. He had also observed the shock-producing effects of prolonged ether anesthesia. All these experimental and clinical observations were correlated in the development of combined anesthesia with nitrous oxide and oxygen and narcotics, known as anoci-association, a method that is forever applicable in the treatment of the sick.

His later researches were concerned particularly with what he called the kinetic system—the brain, thyroid, heart and adrenal glands—and he made comprehensive observations comparing the findings in numerous species having different energy requirements, and in studying metabolism in various types of primitive peoples and comparing it with that in the more energetic peoples of civilized communities. Late experiments also were concerned with the measurement of electrophysical processes in different tissues under varied conditions.

All these experiments and activities and his clinical and surgical observations were correlated into the large program of investigating the fundamental life processes. While he did not succeed in finding detailed answers to all the questions concerned, he did make many valuable contributions which will aid others in coming yet nearer the truth. When he died, he had the satisfaction of the conviction that his work had been directed in the right channel, for in all his observations, within and without the clinic, of the normal and abnormal phenomena presented by man, whether physical or psychologic, he found nothing that he felt was incapable of explanation by biophysical laws. Some of those laws remain yet to be found, but George Crile made fundamental contributions in this field of knowledge, and perhaps more than anyone else, appreciated and publicized the importance that fundamental researches of this kind have in practical clinical and surgical practice.

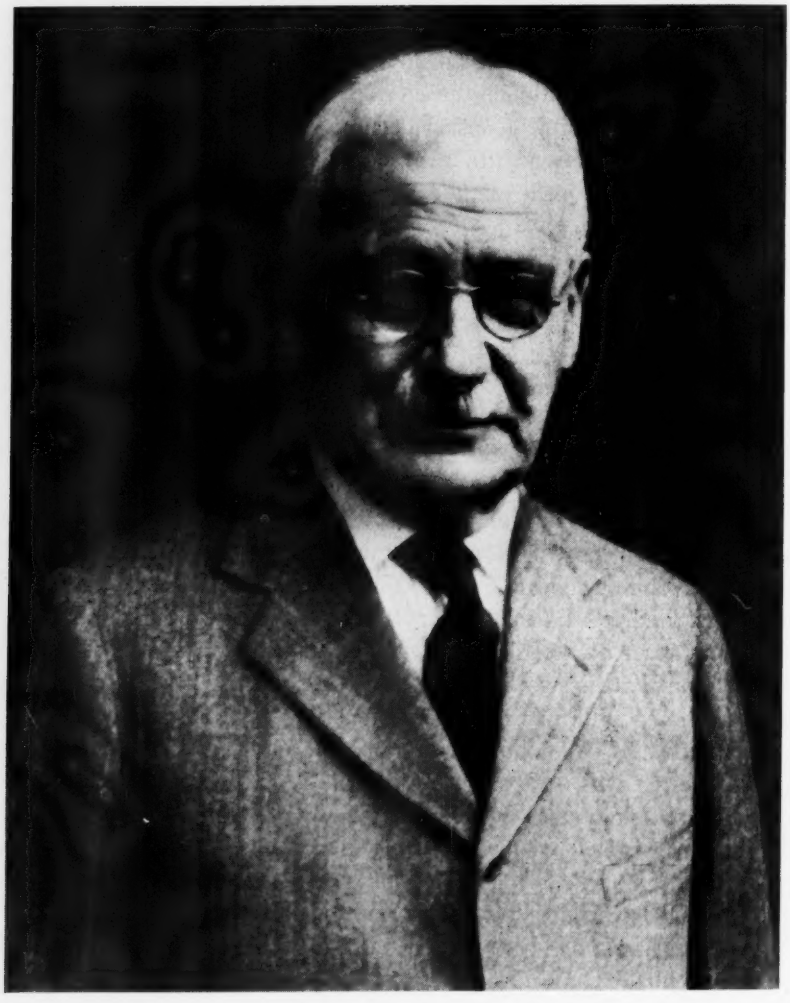
He gave a lifetime of service in the care of the sick; he left the indelible mark of his personality and ideas on a great medical school and on the private clinic he helped to found; he prepared hundreds of students to practice surgery, and inspired many of them to an interest in investigation and research. He also served his country with distinction in World War I, and in the present war, in an advisory capacity. It is given to few men to do more with a life, or to leave a finer heritage.

WILLIAM E. LOWER, M.D.

JOHN MILLER TURPIN FINNEY

1863–1942

Beautiful appreciations of Dr. John M. T. Finney written by Dr. William A. Fisher, Dr. Arthur M. Shipley and Dr. Harvey B. Stone have appeared in different publications, and little can be added to what they have already said. I have used these splendid tributes freely in preparing this memorial.



To those of us, who have had the privilege of coming under the direct influence of Doctor Finney through the years, as students, as interns, and later as colleagues and friends, his passing on May 30, 1942, after a long and very successful life was a great personal loss.

There is little doubt but that his flawless ethics, his kindness and consideration of the patient, regardless of race, creed or color, his sympathy, his con-

summate skill, his gentleness, his patience, his tact, his thoughtfulness, his sound common sense and judgment in dealing with his patients and also with his professional colleagues, made a profound impression on those who came in contact with him.

Doctor Finney was born June 20, 1863, on a plantation near Natchez, Miss. He was the second son of the Rev. Ebenezer Dick Finney, a Presbyterian minister, and Annie Louise Parker Finney. At the time of his birth, his father was pastor of the Greenwood Presbyterian Church near Natchez, Miss. His mother died when he was five months old, and he was taken into the family of a close friend, Mrs. Stephen Turpin, where he lived for three years. Then after the Civil War was over, he went to his maternal grandmother's at Winchester, Ill., where he stayed until 1871, and then to his paternal grandfather's home at Churchville, Md. His father later became pastor of the Presbyterian Church in Bel Air, Md., which is near Churchville, and Dr. Finney lived there, attending the Bel Air Academy until he entered Princeton University. He graduated from Princeton on June 20, 1884, on his twenty-first birthday, and having always desired to become a doctor entered Harvard Medical School in the Fall of the same year. The Medical course was three years, but on account of illness, he lost a year, and did not graduate until 1888, when he was given an appointment on the Surgical Staff of the Massachusetts General Hospital, and his degree was awarded in 1889.

Desiring to return to Maryland, he was advised to see Dr. William S. Halsted, Chief Surgeon of the new Johns Hopkins Hospital. By appointment, he met him on May 7, 1889, on which day the hospital was formally opened. He was immediately given an appointment by Dr. Halsted on the Surgical Staff to take charge of the Surgical Dispensary.

Dr. Finney spent eighteen months on the Surgical Service of the Massachusetts General Hospital, and then was released before his service was completed in order to accept his appointment at the Johns Hopkins Hospital. At the Massachusetts General, he came under the influence of such distinguished surgeons as Dr. C. B. Porter, Dr. John Homans and Dr. Arthur T. Cabot.

On coming to Baltimore, Dr. Finney became associated with the beginnings of the Johns Hopkins School of Surgery, which was founded by Doctor Halsted, and Doctor Halsted's influence on him was profound. He admired Doctor Halsted very much and described him in the Hunterian Lecture he delivered in London, January 17, 1927, as "The greatest American surgical teacher."

The aseptic method of sterilization by heat was beginning to replace the antiseptic solutions and the spray in surgery, and at the Johns Hopkins Hospital asepsis superseded antisepsis. Doctor Finney became an enthusiastic advocate of Halsted's methods, and did much to advance the practical use of the principles developed by Doctor Halsted. He also made many contributions of his own, and during his entire career kept fully abreast of the advances in scientific and clinical surgery, and had the unfailing ability to separate the wheat from the chaff. He was married by his father, on April 20, 1892, to

Miss Mary E. Gross, a member of the first class in the Johns Hopkins School of Nursing, and their marriage was a very happy one in every way. Mrs. Finney and four children; Dr. John M. T. Finney, Jr. and Dr. George Gross Finney, both outstanding surgeons, Eben D. Finney, an architect, and a daughter Mary, Mrs. James S. McDonnell, survive him.

When the careers of many great men in medicine and surgery, who have passed on, are looked up, it is frequently found that there is little on record of the kind of men they were, how they lived, how they thought and how they looked, nothing being recorded except their scientific contributions. It is fortunate indeed for his friends and for the benefit of posterity, that Doctor Finney published, in 1940, his autobiography, "A Surgeon's Life." In addition, there are very fine portraits of him, one in his academic robes, which hangs in the Johns Hopkins Hospital, was painted by Harold Knight, the English portrait painter. Another portrait, which was painted by Thomas Corner of Baltimore, hangs at the Union Memorial Hospital. Both of these portraits are speaking likenesses.

One had only to look at Doctor Finney to know the kind of man he was, and his presence inspired admiration, affection, and a sense of confidence and security to his patients and to his friends.

Although Doctor Finney was from the time he came to Baltimore until Doctor Halsted's death second in rank on the Surgical Staff of the Johns Hopkins Hospital, for some unexplained reason, he was not allowed the privileges of the private or public wards in the hospital for many years. In consequence, as his private practice increased, it became necessary for him to have some hospital where he could send his patients and operate upon them. He selected the Union Protestant Infirmary, an old institution, which in due time, under his stimulating influence and that of a carefully selected visiting staff developed into a very active hospital, the majority of the work being surgical in character. The popularity of the hospital increased tremendously, and in order to obtain a larger bed capacity and to move into a more suitable neighborhood, a campaign was started after the first world war was over in 1919, with Doctor Finney as chairman, to collect funds for a new hospital to be called the Union Memorial Hospital. The success of this campaign was largely due to Doctor Finney's efforts, and the present fine institution has justified his far vision. The operating suite at the Union Memorial Hospital is called the J. M. T. Finney Operating Suite. Doctor Finney remained the outstanding member of the staff to the end, and the hospital was often spoken of as Doctor Finney's Hospital.

Doctor Finney was a charming companion and a delightful raconteur. No one who had the opportunity to listen to his Negro stories, which he loved to tell, and told very well, will ever forget them. He had a rare sense of humor, and many of us will long remember some of his impromptu remarks in his discussions with John Deaver, Charlie Mayo, and others. He had a powerful physique and a prodigious capacity for work. He never seemed to tire, and was able to go on effectively after a hard, long day, when his assistants were all in. He always believed the best of a man, and sometimes this

was taken advantage of. His patience and tolerance were beyond belief, and on several occasions, some of his friends felt that a little less patience would have been advantageous to everyone.

The spirit of good feeling and cooperation, which is so outstanding among the medical profession in Baltimore, which has been so noticeable for many years, was largely due to the influence of Doctor Osler and in an equal degree to Doctor Finney.

On the death of Doctor Halsted in 1923, Doctor Finney was appointed Acting Professor of Surgery and Chief of Service at the Johns Hopkins Hospital and Medical School, which position he held until the appointment of Dr. Dean Lewis in 1925. Ultimately, when he retired at the age of 70, in 1933, he was made Emeritus Professor of Surgery. In 1917, he went to France as Director of Base Hospital No. 18. He was soon made Chief Consultant in Surgery, A. E. F., with the rank of Colonel, and later was made Brigadier General. His outstanding services were largely responsible for the effectiveness of the surgical care of the soldiers in France. He was awarded the Distinguished Service Medal, Officier de la Legion d'Honneur (France), Commander de l'ordre de la Couronne (Belgium).

Many honors were conferred upon him because of his distinguished position in the surgical world. He was lecturer and Honorary Member of the Hunterian Society of London, 1927. He was Bigelow Lecturer in Boston in 1932, and received the Bigelow Medal for "Achievement in Surgery." He was honorary member of the Medical Society of London; Royal College of Surgeons of England; of Ireland and of Edinburgh. Honorary LL.D.'s were conferred upon him by several universities. He was one of the Founders and the first President of the American College of Surgeons, 1913-16, and was closely associated with the organization for many years. He was a member of the American Surgical Association (President 1921), the Southern Surgical Association (President 1912), the Medical and Chirurgical Faculty of Maryland (President 1934-35). Founder member of the Society of Clinical Surgery, and was a member of the Eclat Club and other surgical organizations.

Doctor Finney was particularly enthusiastic about the Southern Surgical Association, and rarely missed a meeting. Some of his best papers were read before this association, and many of us remember well his brilliant and witty discussions.

In recognition of his services to the Medical Corps of the Army during World War I, the large U. S. Army General Hospital at Thomasville, Ga. has been called the J. M. T. Finney Hospital.

Doctor Finney was very much interested in education, as can be shown by the fact that he was a life trustee of Princeton University. (When Woodrow Wilson was made Governor of New Jersey, he was offered the Presidency of Princeton, but declined). He was trustee of Lincoln University; he was trustee of Princeton Theological Seminary; he was president of the Board of Gilman School for Boys; he was President of the Board of the McDonough School. At one time, he was a member of the School Board of Baltimore, and until his death was a member of the State Board of Education. He was

interested in the betterment of Negroes, and was largely responsible for the conversion and rehabilitation of the old Union Protestant Infirmary into the well equipped "Provident Hospital" for Negroes, where Negro doctors and nurses could be trained and could be given adequate facilities to take care of their own people.

Doctor Finney contributed numerous surgical papers, nearly all of which were clinical in nature. He was an ideal clinical teacher; simple, lucid and practical. His surgical judgment, both as an operator and as a diagnostician, was uncanny. At the operating table, he never seemed to hurry but deftness, skill, sureness of method and perfect technic effected careful, rapid, finished work. He was at home in all regions of the body, but in his later years became particularly interested in the surgery of the stomach and intestines, and many of the patients referred to him were operative cases of the most difficult kind. Throughout his surgical career, a considerable portion of Doctor Finney's work was entirely free, and in this connection, I very much doubt whether anyone in this country has ever operated upon more doctors, nurses, medical students and ministers, than he has. Although material success came to him in a larger degree than to many men, his fees were always extraordinarily moderate.

Doctor Finney was brought up as a Presbyterian and was prominent in the councils of this church during his entire life. He was a practising Christian, who did not try to force his religion on his patients and friends, but showed them by his actions and example how a Christian gentleman should live. He was modest and unassuming, but had very definite opinions. He was fearless and had the courage of his convictions. He was keenly interested in sports, particularly those of his alma mater and was frequently seen at football games. He played left end on the Princeton team, when in college and on the Harvard team during his first year in the Medical School. As far as the records show, he is the only man who ever played on both the Princeton and the Harvard football teams. He also enjoyed hunting and fishing, and was an all around real man. He was always interested in reducing the cost of hospital care for people of moderate means, and it was through him that Mr. Frederick Bauernschmidt built the Frederick Bauernschmidt Memorial Building on the grounds of the Union Memorial Hospital, and this was the first building for this purpose erected in this country. He had a genius for friendship and a great number of devoted friends and admirers in every walk of life, who surely miss his always ready willingness to help and give advice.

Doctor Finney was always interested in public affairs and served on many city and state commissions. He was mentioned as candidate for governor and for U. S. Senator from Maryland, but declined both. He was at one time Chairman of the Community Fund, and was for several years and up to the time of his death, Chairman of the Baltimore Chapter of the American Red Cross. He was Chairman of the National Conference of Christians and Jews in Baltimore and gave his time and influence toward the furtherance of this important movement. Without question at the time of his death, Doctor Finney was the foremost citizen of Maryland.

Anyone who was taught by Doctor Finney or who worked with him, unconsciously absorbed some of his qualities and methods, and there are many outstanding surgeons in this country today, who owe their success to his teaching and to his example. I feel there is no one in the surgical world, who has had a more profound influence for the good, both professionally and as to what was right and what was wrong than Doctor Finney had.

It is difficult for those, who did not know Doctor Finney, to understand how all of the qualities which I have mentioned, could be concentrated in one man, who was so modest and unassuming, but they were there in full measure.

Had Doctor Finney lived three weeks longer, he would have been 79 years old, and while during the last two or three years, he had gradually cut down on his operating, he had kept up his other interests and activities as keenly as ever. His death robs the country of a Master Surgeon of international reputation and an outstanding teacher, clinician, and diagnostician; an honest generous fearless citizen; a wise counsellor; a sincere Christian and one who has been an example and an inspiration to the entire medical profession for many years.

JOHN STAIGE DAVIS, M.D.

MONT ROGERS REID

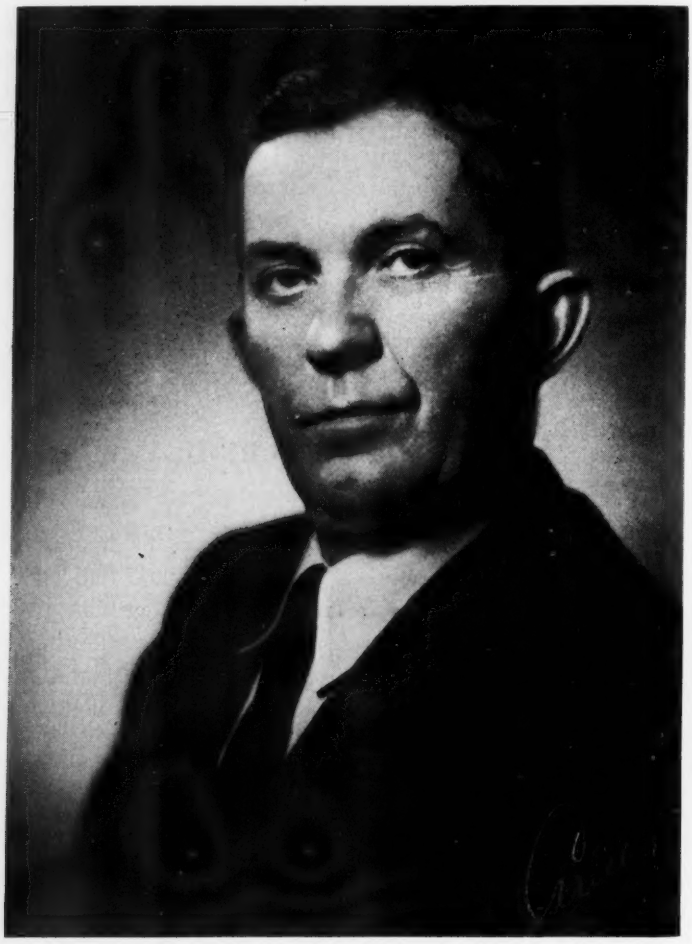
1889-1943

ON May 11, 1943, Mont Rogers Reid died at his home in Cincinnati after a short illness. He was only 54 years of age, and had been extremely active up to the time of his death. In fact, his unselfishness in giving his time and effort to his varied interests of teaching, of contributing to medical knowledge, of managing his busy Surgical Department, and of being the "beloved surgeon" to the community which he loved, contributed to his untimely death.

He was born in Oriskany, a tiny village in the Virginia mountains, on April 7, 1889. His early education was given him by his father who took upon himself the strenuous task of teaching his six sons. After two years of preparatory school, he entered Roanoke College and received his A.B. degree in 1908. Later in life he delighted in recounting stories of his youthful escapades, of the obstacles which he and his family had to overcome, and of the interesting characters who lived in the simple mountain community. Throughout his life he went "down home" as often as he could, fished the streams, hunted in the hills and renewed his old friendships. The calmness, the simplicity and the loyalty which he possessed so abundantly and which contributed so much to his charm, must have had their origin in these early surroundings.

He graduated from the Johns Hopkins Medical School in 1912 after four years of study, during which he was considered a good student with a capacity for thoroughness and industry. His class standing was such that he obtained a surgical internship at the Johns Hopkins Hospitals with Dr. William S. Halsted. This was the beginning of an association with Doctor

Halsted which lasted for ten years, and which left an indelible impression on Reid's Life. From "The Professor," as Doctor Halsted was called by his staff, he learned the gentle, meticulous surgical technic which he championed, obtained an interest in the principles of wound healing which he always maintained, developed a fascination for studying the surgery of blood vessels,



and acquired a remarkable clinical judgment and diagnostic ability based on a searching inquiry into the history, a painstaking physical examination and an unusual alertness to salient facts and findings. His relationship with Doctor Halsted as I saw it from 1919 to 1922 was comparable to that between father and youngest son—affection and vicarious pride in achievement on the one side and admiration and devotion on the other.

Following his internship in Surgery Doctor Reid spent a year in Pathology with Doctor Bloodgood, following which he returned to the Surgical Department. He was assistant resident in Surgery until 1918, when he became resident surgeon, a post he held for three years. In 1922 he went to Cincinnati, with Dr. George J. Heuer, as associate Professor of

Surgery at the University of Cincinnati. The Surgical Department had recently been reorganized and Doctor Reid played an important part in developing it into one of the well recognized surgical centers in America. He acted as visiting Professor of Surgery to the Peking Union Medical College of China in 1925. During his stay there he made many friends among the Chinese, from whom he continued to receive letters and tokens of affection for many years. In 1931, he became Professor of Surgery at the University of Cincinnati and held this position until his death. Under his progressive regime his department, reflecting his surgical enterprise, expanded steadily by contributing to the literature, by training young surgeons and by constantly elevating the standards of surgical care provided the many patients entrusted to it. As Professor of Surgery he assumed his responsibilities to the University of Cincinnati in a most serious manner and spent considerable time and effort in interesting the community in its Medical School. It was largely through his interest and effort that funds were obtained to remodel the Cincinnati General Hospital in accordance with its growing needs. He also secured funds with which he increased the staff of his, and other departments, in the Medical School.

To the Surgical Profession, Doctor Reid was best known for his contributions to the surgery of great blood vessels and of the thyroid gland. He was one of the notable figures in American Surgery and was a member of many important surgical societies among which were the American Surgical Association, Clinical Society of Surgery, Southern Surgical Association, Society of University Surgeons, The American College of Surgeons, and the Central Surgical Association. He always contributed his share to these organizations by serving on various committees and by presenting papers at the meetings. To his students and to the members of his staff he will be remembered as an understanding, approachable, courteous gentleman who never appeared too busy to hear their troubles and joys. He had a real interest in their careers and always found time to discuss their future with them and to give them sound advice. He had infinite patience and won his point more often by persuasion than by force. Having made his decisions carefully he was not easily dissuaded from them. He was an impressive teacher who excelled more in instructing smaller groups on ward rounds than in holding large and formal clinics. He understood the Halsted principles of surgery as well or better than any of Doctor Halsted's protegés, and taught them well to his staff and students by example, by his lectures, and by his writings. He spread the Halsted philosophy of careful attention to those details of surgery so necessary to ensure kindly wound healing and an uncomplicated convalescnce. His house staff loved him and were to him a source of never-ending interest and delight.

With his kindness, his unselfness and his winning personality he quickly assumed an important position in the community. He was extremely interested in civic affairs and by his own efforts, and often with the support of the city's most influential citizens, he did much to make Cincinnati a better place in which

to live. His patients came from every walk of life and to each of them he gave of himself unsparingly. He was noted for his kindness to his patients, for his genuine concern for their comfort and for his attention to even the smallest detail of their treatment. The city's wide concern over his illness and the evidences of affection shown at his funeral services bear witness to the esteem in which he was held.

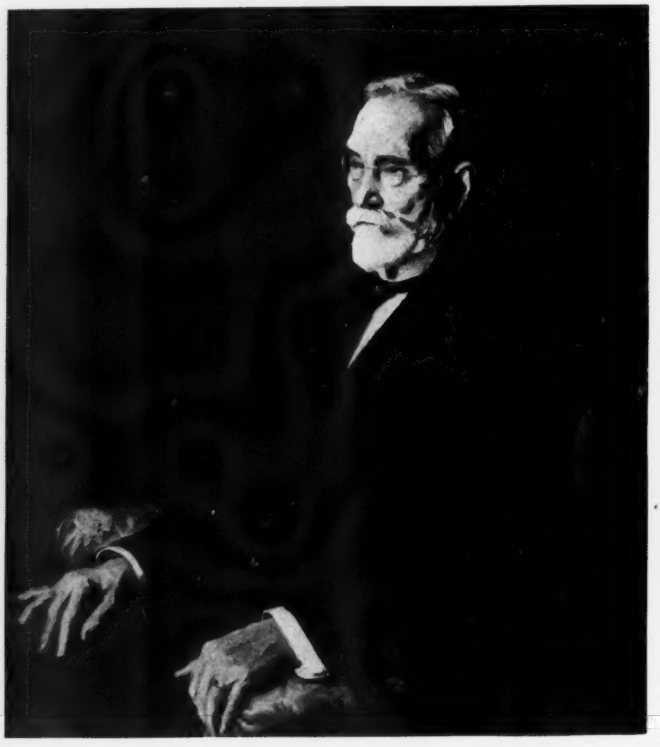
Mont Reid had a well-rounded life, accomplished more than is permitted to many, and with his death there passes from the scene a lovable character, a superb surgeon and a most loyal friend.

B. N. Carter, M.D.

EDWARD JOSEPH ILL

1854-1942

Edward Joseph Ill, physician, surgeon, gynecologist, obstetrician, and one of New Jersey's great citizens, was born in Newark, May 23, 1854, and died on June 8, 1942, at the venerable age of 88 years. He was the son of



Dr. Fridolin and Julia Ill, who migrated to this country in 1850, being early political revolutionists, who fled from Germany.

His early education was obtained in the public schools of Newark. In 1875 he was graduated from the College of Physicians and Surgeons at Columbia University, and immediately went abroad to continue his studies for a period of two more years in Vienna, Freiburg and Strassburg.

Upon completion of his studies abroad, he returned to enter practice with his father in Newark. He went into general practice. The small laboratory which he possessed was equipped only with a microscope, and his library contained 20 standard reference books. In November of 1877, having been in practice for only a year, he had an opportunity to remove a shawl pin from the right bronchus of a child. He immediately published this experience in the New Jersey Medical Record.

His first appointment to a hospital staff was to the German Hospital in Newark. Soon he became interested in gynecology, and one of his early reports was of 37 operative cases on the cervix, for lacerations which he reported before the New Jersey State Medical Society. An early contribution, and one of importance, was a report of a case of resection of a gangrenous sigmoid, with recovery.

Doctor Ill's interests were varied, even at this early age. In 1879 he was made the School Commissioner of the City of Newark, and rendered a great service to his community by being instrumental in introducing a law which prohibited children, who had been ill with scarlet fever, from returning to school until a doctor's certificate, certifying that contagion was no longer present, had been obtained. Great opposition to this law was encountered, for the laity felt that it was simply another way for doctors to collect a fee. Doctor Ill obtained a promise from all the doctors in his community that no fee would be charged in issuing such a certificate. He was one of the founders and the first president of the Academy of Medicine of Northern New Jersey. He contributed largely to the library, by giving numerous rare medical volumes. For a period of 32 years he was on the Board of Directors of the Prudential Insurance Company, and was later made Chairman of the Finance Committee.

At the age of 76, he took a most active part in the battle waged at this time, to prevent the use of impure ergot in maternity cases. He was an early advocate that intervention by the Federal authorities should be instituted to bar the use of impure and adulterated drugs of all kinds, and spent much time in Washington for this purpose.

Doctor Ill was a strong character, and though frail physically, possessed a tremendous vitality. He was open-minded, kindly, at all times exceedingly forceful, and always an understanding physician.

In 1900 he was made a member of the Southern Surgical Association. He attended its meetings frequently, and contributed to its discussions. He was a member of numerous surgical and medical societies of his own State and of the nation. He contributed in abundance to the literature, principally on gynecologic subjects.

On the anniversary of his 85th birthday, the City of Newark, through the Academy of Medicine of Northern New Jersey, did him honor. This was an occasion, and distinguished men from many parts of the country came to honor him. He was greatly impressed by the ovation, and particularly by the delivery of the highly flattering addresses. When asked, after this

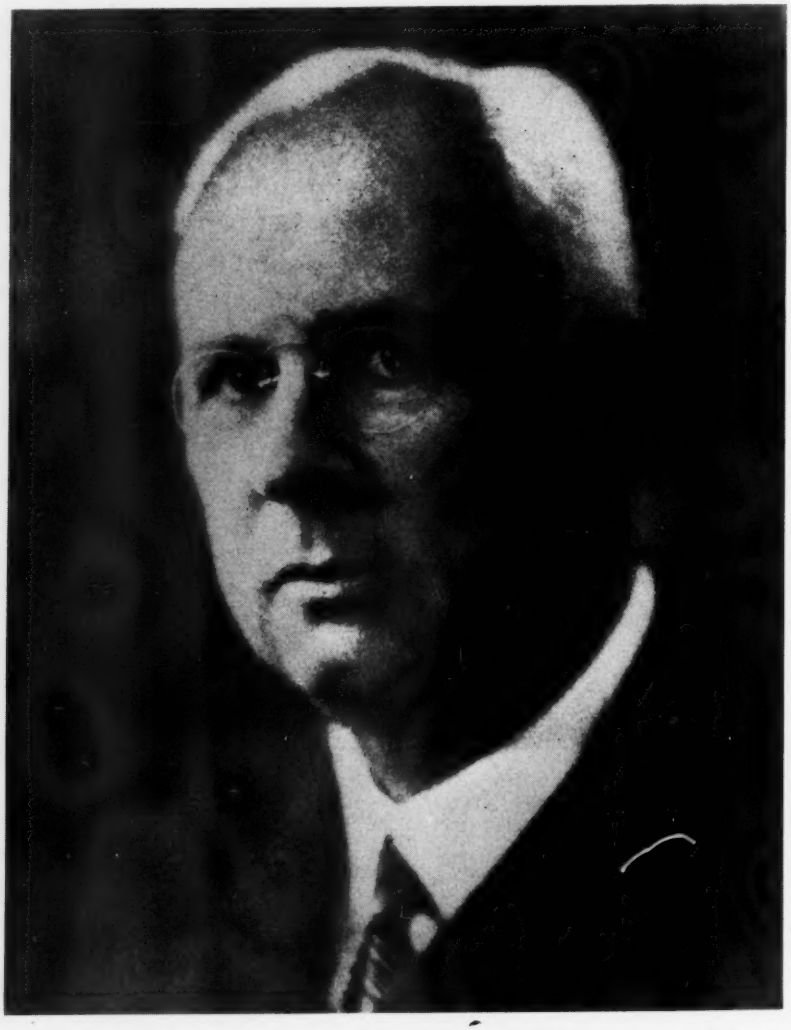
meeting for his impressions, he said—and this was very significant of his whole character: "For all these honors that were given me, I have felt that I have only done my duty to my profession, my family and my patients."

HENRY CAVE, M.D.

HENRY DAWSON FURNISS, M.D., LL.D.

1878–1942

On January 25, 1942 Dr. Henry Dawson Furniss died of a heart ailment at his home, 6 Henderson Place, New York, N. Y.



Doctor Furniss was born in Selma, Alabama, on March 25, 1878, the son of John Perkins and Elizabeth Matthews Dawson Furniss. He attended the University of Alabama from 1894 to 1896 and, in 1928, received the honorary

degree of Doctor of Laws from that school. Doctor Furniss left the University of Alabama and attended the University of Virginia, where he was graduated in Medicine in 1899. He went to New York and took the examinations for internship at the New York Post-Graduate Hospital, and went on service in this hospital on October 1, 1899, for a two-year appointment. During this time he worked under eminent surgeons, including Dr. Robert T. Morris, a Senior Fellow of this Association, and the late Dr. Hermann Boldt, who also was a member.

Upon completion of this hospital appointment he went to Europe and attended clinics. Later he returned to Selma and practiced there several years. He gave up his practice in Selma and went to New York where he became associated with the Post-Graduate Hospital Medical School, to which institution he was appointed Instructor in Gynecology in 1904, Assistant Professor in 1910, and Professor in Gynecology in 1917 until 1927, and was Attending Gynecologist at the Hospital during that period. At the completion of this long term of service he resigned his professorship and became Consulting Gynecologist to the Post-Graduate Hospital. He held the following positions also: Consulting Gynecologist, St. Agnes Hospital, White Plains, N. Y., All Souls' Hospital, Morristown, N. J., Hackensack Hospital, Hackensack, N. J. ; Broad Street and Holy Name Hospital, Teaneck, N. J., and St. Luke's Hospital, Newburgh, N. Y.; Consulting Cystoscopist, N. Y. Infirmary for Women and Children; Attending Surgeon, Fifth Avenue-Flower Hospital and Metropolitan Hospital, New York, being Professor of Gynecology and Attending Gynecologist to the former.

During World War I Doctor Furniss served in the United States Army Medical Corps with the rank of Captain, and at the end of the war in 1918 he was Chief Surgeon at Camp Hancock, N. J.

Doctor Furniss enjoyed a large private practice and was beloved by his patients. He took great interest in attending meetings of the various medical societies and associations of which he was a member, and always took an active part. He was possessed of an unusual mechanical ability which enabled him to devise various instruments and ingenious devices which were used by the profession. He is well known for the catheter and the intestinal clamp which bear his name, and was a genius for making little improvements on other instruments to suit his own needs.

In addition to gynecology he was greatly interested in female urology and contributed over fifty articles to the literature on these two subjects.

Doctor Furniss was a Diplomate of the American Board of Obstetrics and Gynecology, and a Fellow of the American College of Surgeons and New York Academy of Medicine, a member of the American Medical Association, American Urological Society, a Life Fellow of the New York Obstetrical Society, and an Honorary Fellow of the American Association of Obstetricians, Gynecologists and Abdominal Surgeons. He was elected a member of the Southern Surgical Association in 1929 and was a constant attendant at most of the meetings. He always looked forward to the meetings of this

Association, and told many of us that he preferred attending these meetings to any other.

He is survived by his wife, the former Ruth Kellogg Pine, whom he married in 1912, and three sons: Henry Dawson Furniss, Jr., James Pine Furniss, and Warren Todd Furniss, and two grandsons, Henry Dawson Furniss 3rd and Peter Randall Furniss.

Doctor Furniss was truly a Southern gentleman, soft-spoken, kind-hearted, and well liked by his intimates, and, as one of his close friends stated, he was almost too honest for his own good. At times his frankness may have been the source of some embarrassment to himself. Nevertheless, he was strongly admired for this very quality.

His untimely death at the age of 64 was a great shock to all of us, and he will be greatly missed at the meetings of this Association.

JOSEPH E. J. KING, M.D.

ROBERT COALTER BRYAN

1873–1941

ROBERT COALTER BRYAN was born at "Brook Hill," Henrico County, Virginia, June 27, 1873, the second son of Joseph and Isobel Stewart Bryan.

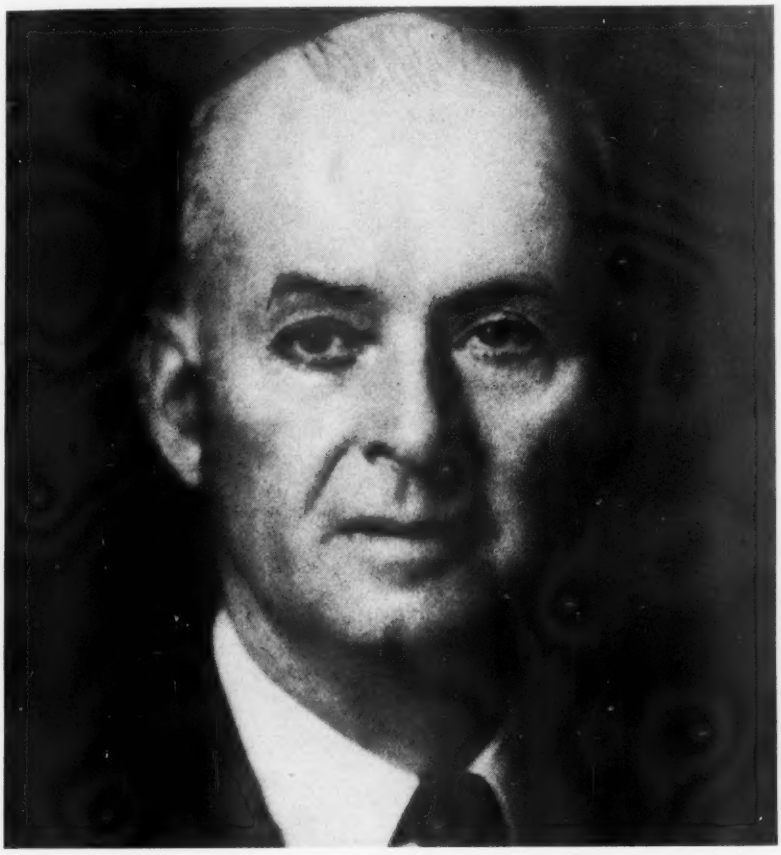
He was educated at private schools in Richmond; he attended the University of Virginia, and later spent two years in the Engineering School at the University of Pennsylvania, where he played an active part in college theatricals. In 1895 he entered the College of Physicians and Surgeons in New York City, and graduated with distinction, later going abroad for a year's residence study in Vienna. Returning to Richmond, Doctor Bryan began the practice of medicine, and shortly won recognition as one of the city's outstanding surgeons.

Doctor Bryan was Professor of Anatomy from 1904 to 1911 at the University College of Medicine, which was later merged with the Medical College of Virginia, and for some years was Professor of Genito-Urinary Surgery at the Medical College of Virginia, from which position he retired in 1932. Doctor Bryan served on the staffs at Stuart Circle and Memorial Hospitals in Richmond. He was a founder of Grace Hospital, Richmond, where for a number of years he was chief surgeon.

During the first World War Doctor Bryan served as a member of the Commission of the American Red Cross to Roumania and later, in France, gave his valued services at the hospital at Juilly.

In May, 1916, Doctor Bryan was commissioned a first lieutenant in the Medical Reserve Corps, U. S. A., and in March, 1917, was commissioned first lieutenant, Officers Reserve Corps, Army of the United States. On June 5, 1917, he received the commission of major in the medical section, Officers Reserve Corps, United States Army.

He held membership in the Richmond Academy of Medicine, Medical Society of Virginia, American Medical Association, Southern Medical Association, American Association of Genito-Urinary Surgeons (President in 1935), Southern Surgical Association (Vice-President in 1928), Tri-State Medical Association of the Carolinas and Virginia (of which he was a former President), American Urological Association, and the International Society of Urology. He was a Fellow of the American College of Surgeons.



His countless acts of kindness, and his assistance to young physicians are known only to the recipients of his quiet, covert generosity. Few men have been held in such high esteem by so many.

For the last six years of his life Doctor Bryan was a constant sufferer from arthritis, and on Christmas Eve, 1941, he died suddenly at his home in Richmond.

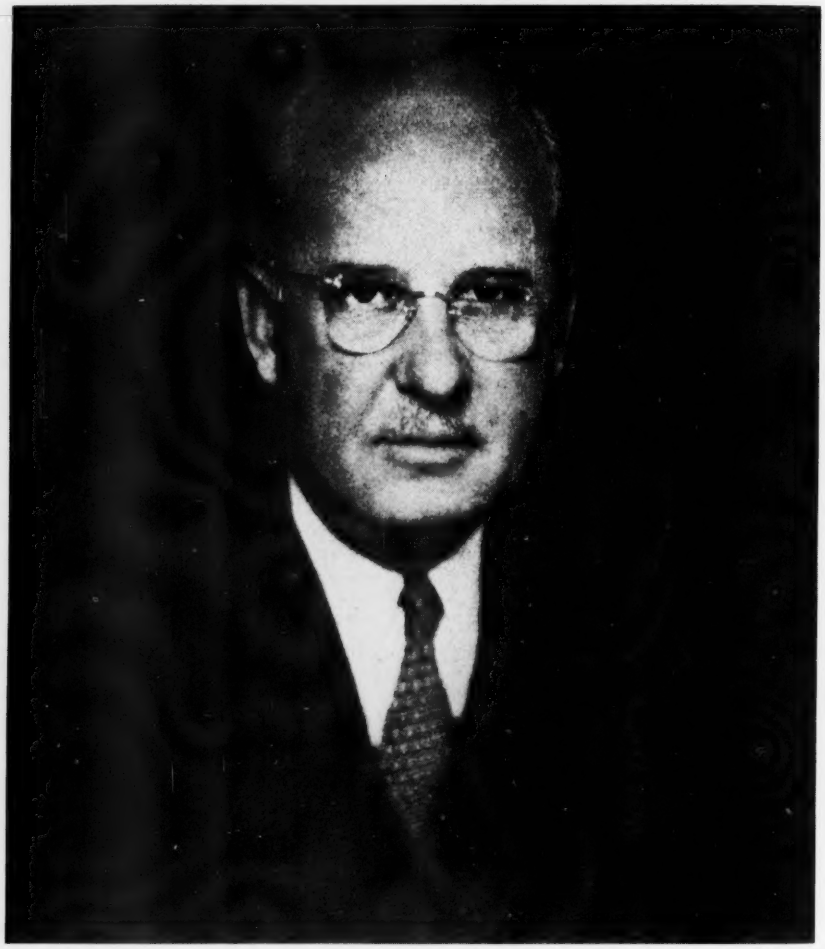
In October, 1914, Doctor Bryan married Miss Grace Hamilton, of Oak Hill, Maryland, who survives him, with two sons, Jonathan Bryan, III, and Robert Carter Bryan.

J. Shelton Horsley, M.D.

ROSS ARLINGTON WOOLSEY

1877–1942

Ross Arlington Woolsey was born at Knoxville, Illinois, December 23, 1877. His elementary and premedical education was completed in Galesburg, Illinois, and he entered Marion-Sims-Beaumont Medical College in 1900,



graduating in 1904, after it became the Medical Department of St. Louis University. Two years internship at Frisco Hospital, Springfield, Mo., followed, and he returned to St. Louis, in 1906, entered the St. Louis Frisco Hospital and faithfully served the Frisco Employees Hospital Association as House Surgeon, Surgeon-in-charge and Chief Surgeon, until his accidental death on February 23, 1942, at St. Louis.

On April 17, 1912, he married Mary Ricaud Beck; two children, Anne Beck (Mrs. Eugene L. Pearce, Jr.) and Ross A. Jr. (Lt. Field Artillery, U. S. A.), blessed the union.

Doctor Woolsey became a member and an active participant in the meetings of the following professional organizations:

American College of Surgeons
American Board of Surgery
St. Louis Medical Society
Missouri State Medical Association (Pres. 1937)
American Medical Association
St. Louis Clinics (Pres. 1926-29)
St. Louis Surgical Society
Mississippi Valley Medical Association
American Association for the Surgery of Trauma
American Society for the Control of Cancer
Western Surgical Association
Southern Surgical Association
Southern Medical Association
American Association of Railway Surgeons
American Association of Chief Surgeons

Enjoying an extremely wide circle of friends, Ross Woolsey led a very active social and professional life, and fully relished every day of it. He possessed the rare ability to hew to the line in the interests of those whom he served, meanwhile retaining the loyalty, respect and affection of the personnel involved.

Although tireless at his work, he firmly believed in adequate recreation for the busy doctor, and sought his relaxation in golf, and the woods and streams of the Ozarks, and no better sportsman ever wet a line.

Beloved by his host of friends, he left an indelible imprint on the hearts of his close companions. His family life was a model of serenity and happiness, his wife and children his most cherished possessions, around whom all other activities and ambitions centered. To all who knew and loved Ross Woolsey, his passing leaves only kindly memories of a loyal friend, an ever welcome companion, a staunch character and a sound surgeon, whose destiny had been fully compensated by accomplishment.

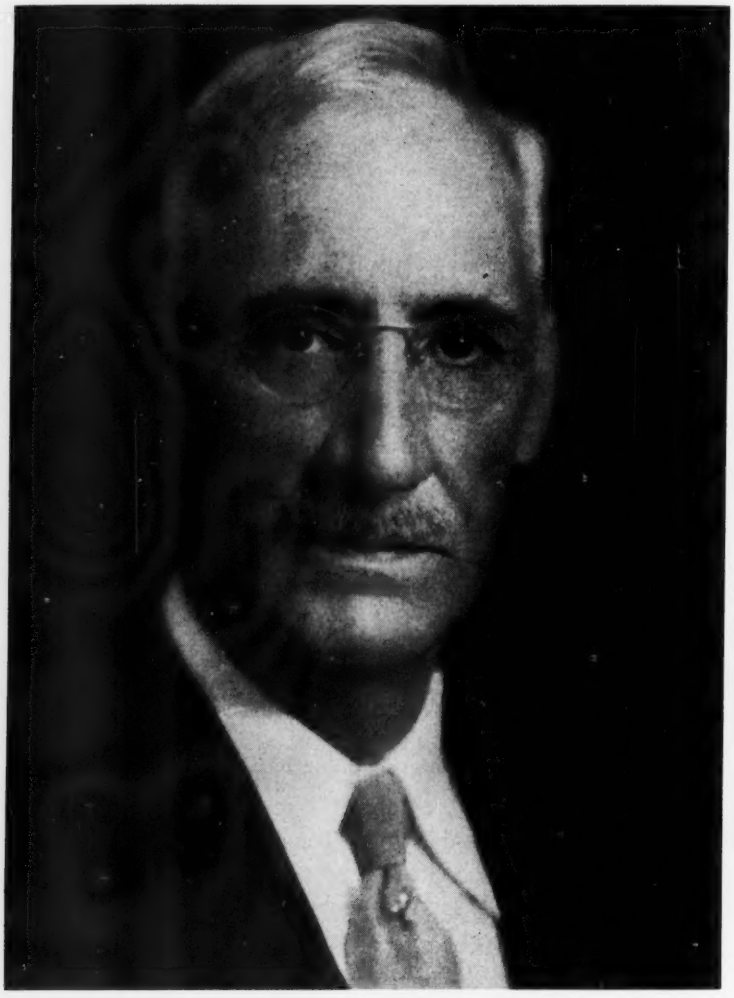
F. W. Bailey, M.D.

THOMAS PINCKNEY WARING

1867–1943

Dr. Thomas P. Waring, fellow of the Southern Surgical Association since 1911, died at his home in Savannah, Georgia, January 8, 1943, after a short illness. Coming from a family of medical men, Doctor Waring was born in Savannah in 1867, the son of Dr. James Johnston Waring and Mary Alston Waring. He lived in only two locations during his entire life, the house where he was born and the house where he died. After attending the Graylock Institute at Williamstown, Mass., he graduated A.B. from Yale College, in 1889, and received the M.D. degree from the College of Physicians

and Surgeons in New York, in 1892, where he stood first in his class. Following an internship at Bellevue, he travelled and studied abroad, visiting Scotland, Germany and Austria, and then began a half-century of practice in his home town of Savannah.



Doctor Waring, a Fellow of the American College of Surgeons, became one of the leading surgeons of Savannah and the state of Georgia. At first he served in the capacity of a junior partner with the late Dr. Raymond B. Harris, as was the custom in those days. While associated with Doctor Harris, Doctor Waring became head of the Telfair Hospital. Then, in 1910, Dr. John W. Daniel invited him to become coöwner of the Oglethorpe Sanatorium. He accepted and built a surgical unit and nurses' home on the land, and at the time of his death he was sole owner. On more than one occasion he was president of the Georgia Medical Society, of Savannah, one of the oldest local medical organizations in the country, corresponding to the county medical

society in other places. Due probably to his modest, retiring disposition, Doctor Waring was not a frequent speaker at the meetings of the Southern Surgical Association, and added but few articles to surgical literature. However, his professional knowledge and surgical ability were well recognized, and he enjoyed one of the most extensive and select practices in his part of the state.

He was a vigorous person, pursuing widely varied activities, ever young in spirit and in his response to life's demands and fields of endeavor. He had a host of friends throughout his native town, and held a warm place in the hearts of his medical confreres. The description "scholar and gentleman" fitted him well. He was a student and inveterate reader, and always kept abreast of the times, in medicine and other activities. Doctor Waring was a charter member of the Society of Colonial Wars in Georgia, and served as its Governor before becoming deputy governor general. He was an active member of several social organizations.

In 1902 he married Miss Martha Gallaudet Backus, who passed away shortly after the death of her husband. Two children survive, one son, Dr. Thomas Pinckney Waring, Jr., and one daughter, Mrs. Frederick M. Stetson. The present T. P. Waring represents the fourth generation of practicing physicians in direct line in the family. The mayor of Savannah paid the following tribute to Doctor Waring:

"In the death of Dr. T. P. Waring Savannah lost not only a physician of outstanding ability, one who was recognized by the medical profession here and throughout the state and elsewhere as a leading surgeon and practitioner, but has likewise lost a citizen who loved Savannah, whose interests were all centered in Savannah, and who was devoted to everything that promoted the welfare of the city of his birth and life. The passing of a man like Doctor Waring is a distinct loss to the community. He represented the type of citizenship that exemplified the finest attributes of character. He will be long remembered, not only in his profession and among those whom he served in a professional way, but likewise by a host of Savannahians who knew and appreciated his sterling worth to our city."

FRANK K. BOLAND, M.D.

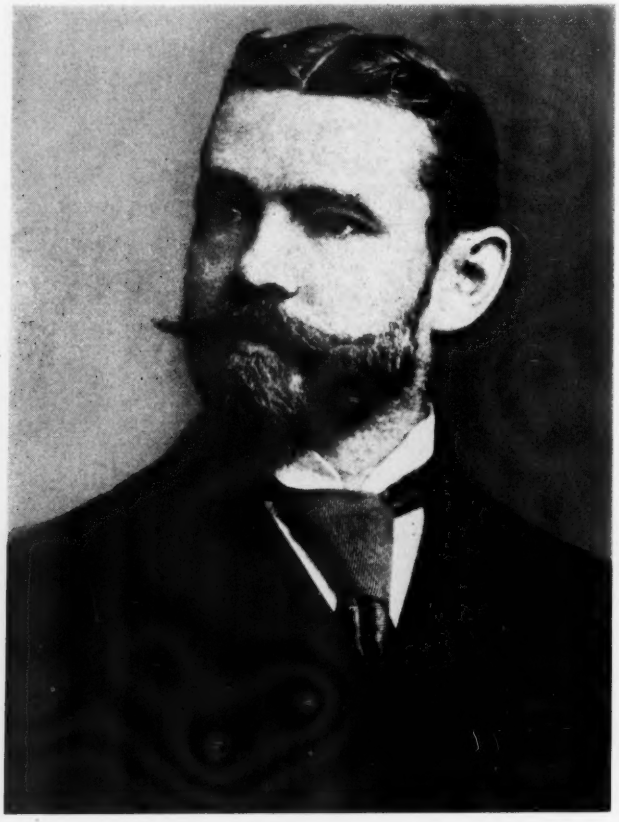
HERMANN JOHANNES BOLDT

1856–1943

Hermann Johannes Boldt, son of Hermann and Amalie (Krüger) Boldt, was born in Germany on June 24, 1856, at his father's estate, Neuentempel, near Berlin. He came to New York with his parents in 1865, went through the public and high schools, received private instruction in languages and mathematics, and devoted his evenings to the study of pharmacy, passing the examination in the latter study in 1877. He commenced the study of medicine in 1875, and was graduated from the Medical Department of New York University in 1879. After graduation he practiced medicine in New York and passed all his professional life in that city. For many years he spent the summer months in the hospitals of Europe. On August 20, 1891, he married

Miss Hedwig Krüger in Berlin. They had one son, Hermann Johannes Boldt, Jr., who was killed in 1918, in the first World War.

Doctor Boldt was Professor of Gynecology at the Post-Graduate Medical School from 1891 to 1917, then Emeritus Professor. He was one of the founders of the German Poliklinik and of St. Mark's Hospital. He was



Gynecologist to both of these, and Consulting Gynecologist to the New York Post-Graduate Hospital, Stuyvesant, Polyclinic, St. Vincent's, Beth Israel and Union Hospitals.

He was one of the founders, formerly a member of the board of governors, and Fellow of the American College of Surgeons, member of the Southern Surgical Association, American Gynecological Society, New York Obstetrical Society, New York Pathological Society, American Medical Association, Gynaecological Society of Great Britain, New York Academy of Medicine, Royal Society of Medicine, Association of Military Surgeons of the United States, and various local societies.

He was an investigator into the physiologic action of cocaine and a prolific writer on all aspects of gynecology. Besides many articles in medical journals, he wrote the chapters on "Benign and Malignant Neoplasms of the Vulva and Vagina and of the Uterus," in the textbook, Clinical Gynaecology by

Eminent American Teachers, published by J. B. Lippincott Co., in 1895. He was also a contributor to the Enzyklopädie der Geburtshilfe und Gynäkologie, published in Leipzig in 1900. He invented an operating table for abdominal surgery which won a medal at the Paris Exposition in 1900, and also a modern examining table for office use.

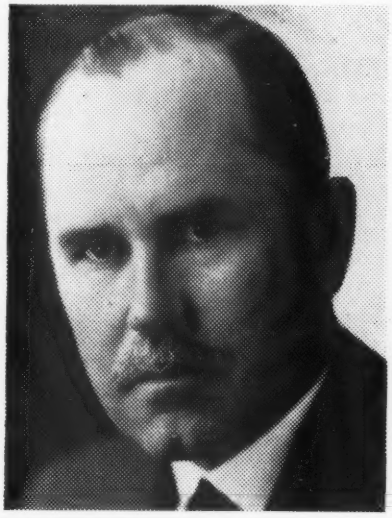
Doctor Boldt had retired from practice and spent his winters at St. Petersburg, Florida, where he died on January 12, 1943.

RAYMOND P. SULLIVAN, M.D.

CHARLES WATTS FLYNN, JR.

1884–1943

Doctor Flynn, a Senior Fellow of the Southern Surgical Association, died at his home in Dallas on August 13, 1943. It is particularly appropriate that this memorial should appear in the Transactions of this organization as the Southern Surgical Association was the professional organization most



beloved by him. Beginning with his election to Fellowship in 1923, he attended practically all its meetings, occupied a chair on the front row of the auditorium with regularity, and always brought back to his students in the Medical School a detailed account of the surgical advances annually presented at its meetings. He was honored by election to the Vice-Presidency of the organization in 1937.

Charles Watts Flynn was born at Lakeland, La., and received his preliminary education at the Sanders Preparatory School, Baton Rouge, La., and the Louisiana State University, where he received the degree of Bachelor of Science in 1905. In June, 1911, he received his Medical Degree from the Medical Department of the University of Pennsylvania. After serving an internship in Pittsburgh, Pa., he located in Dallas in 1912 and engaged in the practice of general surgery until his death.

He was happily married to Miss Mary Watts Knight, daughter of a distinguished, pioneer lawyer, R. E. L. Knight, in 1917.

He was associated with Baylor University College of Medicine immediately on coming to Dallas and later became Professor of Surgery and Chief Surgeon of Baylor Hospital. He was an excellent teacher, genial, kindly and meticulous in his relation to students and professional conferees. Illness forced him to retire from active duties before his death and he became Honorary Professor of Surgery at the Southwestern Medical Foundation Medical School now located in Dallas and held this position at the time of his demise.

Doctor Flynn was a Fellow of the American College of Surgeons, Fellow and former President of the Texas Surgical Society, and a member of numerous social and professional organizations.

CURTICE ROSSER, M.D.

ARCHIBALD JOHNSTON BUIST

1872–1943

On September 12, 1943, occurred the death of Dr. Archibald Johnston Buist, of Charleston, South Carolina. Doctor Buist was the son of Dr. John Somers and Margaret Sinclair (Johnston) Buist, and was born in Charleston February 7, 1872. His preliminary education was obtained in the Charleston Schools, Lawrenceville Academy (New Jersey) and Princeton University, graduating from this institution in 1893 with the B.A. degree. He then returned to his native city and entered the Medical College of the State of South Carolina and graduated in 1896 with first honors. After serving as intern in the Charleston City Hospital for a year he went to New York and took post-graduate work in the New York Lying-in Hospital, and other New York Hospitals.

As a student in the Medical College Doctor Buist began his long teaching career, being an assistant in the Department of Pathology and Bacteriology from 1895 to 1899; assistant in General Surgery from 1895 to 1899; Lecturer in Minor Surgery and Bandaging from 1899 to 1904; Professor of General Surgery from 1904 to 1910; Professor of Abdominal Surgery and Gynecology 1911–1912, and from 1912 until 1939 he occupied the chair of Professor of Gynecology. In 1939 he tendered his resignation to the Board of Trustees and was elected Emeritus Professor of Gynecology. Doctor Buist was singularly well equipped to teach, in that he never used notes in his classes and he illustrated the points of whatever subject was under discussion by descriptions of personal experiences having a bearing on the matter. His students respected him for his broad knowledge and his willingness to discuss with them any problems they might bring to him.

Doctor Buist was a man who enjoyed being in the company of his friends on fishing trips, for he was a keen fisherman. His genial nature and enjoyment of life was a delight to his friends and it was on such a fishing party that he died, as he had lived, in the company of close friends.

Many honors came to Doctor Buist. During World War I he served as

chairman of the Third District Advisory Board for South Carolina; he was chairman of the local chapter of the American Red Cross; President of the Board of Trustees of the Charleston Museum; he was a member of the American Board of Surgery, the Southern Surgical Association (1913), the American and Southern Medical Associations, and a past President of the Medical Society of South Carolina.

Doctor Buist was twice married: in 1899 he married Miss Alice Stock Mitchell, by whom he had a son, Dr. Archibald Johnston Buist, who is at present serving in the United States Navy. After the death of his wife he married Mrs. Elizabeth Roller Gestefeld, who survives him.

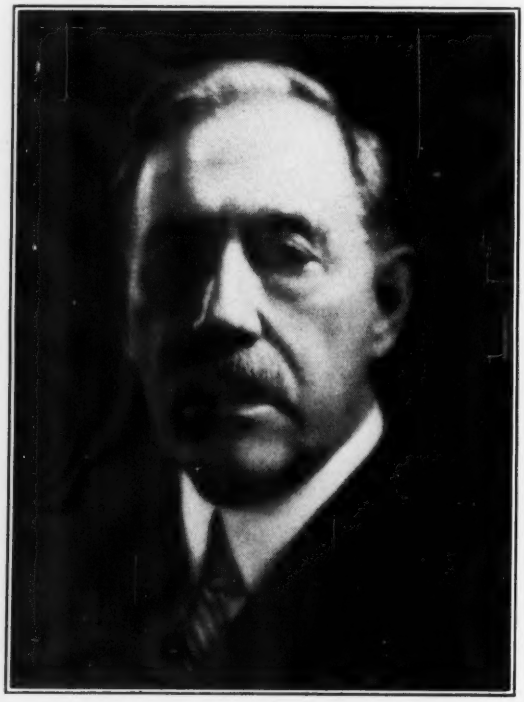
No higher praise can be given a man than to be able to say, at the end of his life, that "Here was a man who loved humanity and spent nearly half a century in service to humanity's common need."

R. S. Cathcart, M.D.

GRANVILLE S. HANES

1864–1943

Doctor Hanes was born at Haysville, Mason County, Tennessee, in 1864, and obtained his education in the common schools of his home State. Early in his life he made the acquaintance of a physician in Indiana who became so impressed with his energy that he paid his tuition in the Medical College of Indiana. At the time of this friend's death he was stranded in Indianapolis and went to Mr. W. D. Allison to apply for a position in order to earn enough money to complete his medical education.



Times were hard and he was informed that nothing could be offered. He insisted that he had no place to sleep, and at the suggestion of one of the clerks, Mr. Allison let him sleep on an operating table in the store. He made himself so useful that he was put on the road and proved the best salesman the firm ever had.

Some years later he canvassed the Louisville profession and met Dr. Joseph M. Mathews who induced him to enter the Hospital College of Medicine, where he made many valuable friends, including Dr. Lewis S. McMurtry, and obtained his Doctorate in Medicine there in 1900. Soon he became clinical assistant to Doctor Mathews and his associate in private practice, learning much from the wise counsel of his friend. A Nedifik sofa in their office was used for the knee-chest position in examination of the rectal cases, and Doctor Hanes found that he could look directly down into the bowel and that it was

fully distended with air, permitting a complete view of the tube easily when thus readily filled with air. This led Hanes to devise the table which he used throughout his life and still retains his name.

Doctor Hanes was a man with an inquiring mind, and he had what Weir Mitchell called a fermenting brain; full of ideas, many of which were of therapeutic value. Often his ideas caused debate. Rarely this was caustic, especially among some of his envious competitors. He had a very pleasing personality, but was rather fixed in debate; and a good raconteur.

Doctor Hanes was Professor of Diseases of the Rectum, University of Louisville Medical School; Fellow of the American College of Surgeons; Fellow of the Southern Surgical Association; President of the Proctological Society; and a Major in the Medical Corps of the United States Army.

At a meeting of the Kentucky and Tennessee section of the American College of Surgeons in the Brown Hotel the Chairman of the meeting turned that body over to Hanes, Haggard and Hendon, all master entertainers, and the pleasure of the occasion was unbounded. What a pity that no record persists of their remarks. Doctor Hanes gave great care to his patients, and his devotion was splendid, in return, he held their appreciation and regard until the end of his life, which was tragic. But true to form, he passed out as he lived—dramatically. Those who knew him best loved him most.

J. Garland Sherrill, M.D.

FRANK L. BARNES

1872-1943

On October 2, 1943, Dr. Frank L. Barnes died at his home, 10 Chelsea Place, Houston, Texas, of coronary occlusion.

Doctor Barnes was born September 26, 1872, in Trinity, Texas. He received his academic education at Hill's College, Waco, Texas, while his Medical education was obtained at the College of Physicians and Surgeons, Baltimore, Maryland, in 1896. While in medical college he served as prosector in anatomy. Following his graduation he served an internship in Mercy Hospital, Baltimore, Maryland.

He was a member of the American Medical Association, Harris County Medical Society, South Texas Postgraduate Medical Assembly, Fellow of the American College of Surgeons, Founder Member of the Texas Surgical Society, Founder Member of the American Board of Surgeons and a Fellow of the Southern Surgical Association. During the Spanish-American War he served as an assistant surgeon to the Army, being stationed at Galveston, Texas.

Doctor Barnes was one of the few remaining pioneer Texas surgeons, having practiced at Trinity, Texas, on horseback, with saddle-bags, prescribing and dispensing his own medicines. He had an extensive surgical practice, beginning his surgery at the time it was done in the home or in his office and then sending the patient home in a wagon.

In 1908, he built a hospital in Trinity, Texas, where he did an extensive surgical practice until 1915 when he moved to Houston, where he remained until his death.

Doctor Barnes married Miss Alice Johnson of Trinity, Texas, June 8, 1898, and they had two daughters, Mrs. Aubury Calvin and Mrs. William M. McKinney, of Houston, and two sons, Edward F. Barnes, now serving in the Navy, and Dr. Payton Barnes, of Houston, Texas.

Doctor Barnes occupied a very prominent position in Surgery in Texas, and was known for his great surgical judgment. He was of a retiring disposition but never failed to take a positive stand on the right side of every question concerning Medical Ethics. His loss will be felt not only in Houston but in the entire State of Texas.

Besides his immediate family he was survived by two brothers, William and Jesse Barnes, of Trinity, and three sisters, Misses Hattie, Mattie and Mary Barnes, all of Trinity.

CHARLES C. GREEN, M.D.